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MACHINERY

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CONTENTS OF THIS NUMBER

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In July MACHINERY the advantages that may be gained by replacing castings with pressed steel parts when the conditions of design and use of the product permit, will be dealt with comprehensively.

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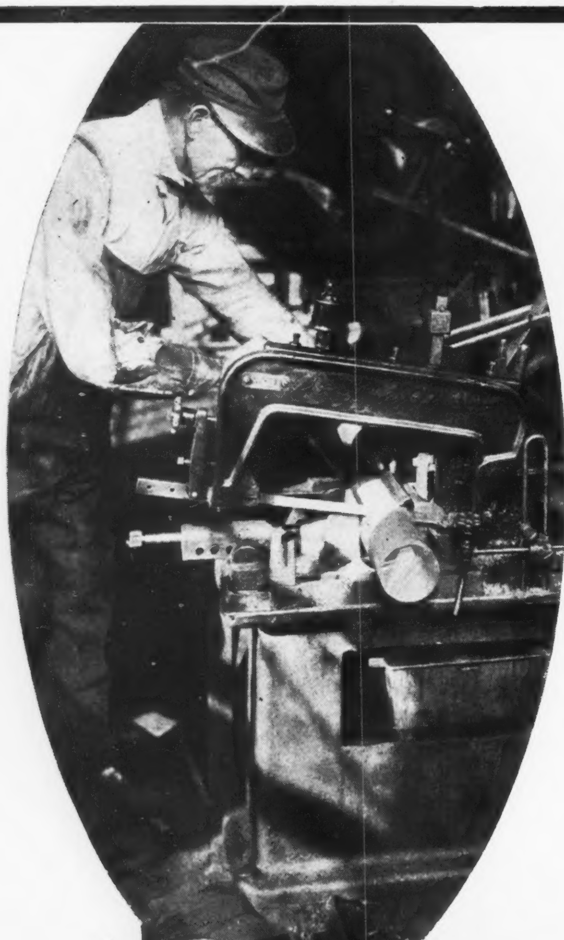
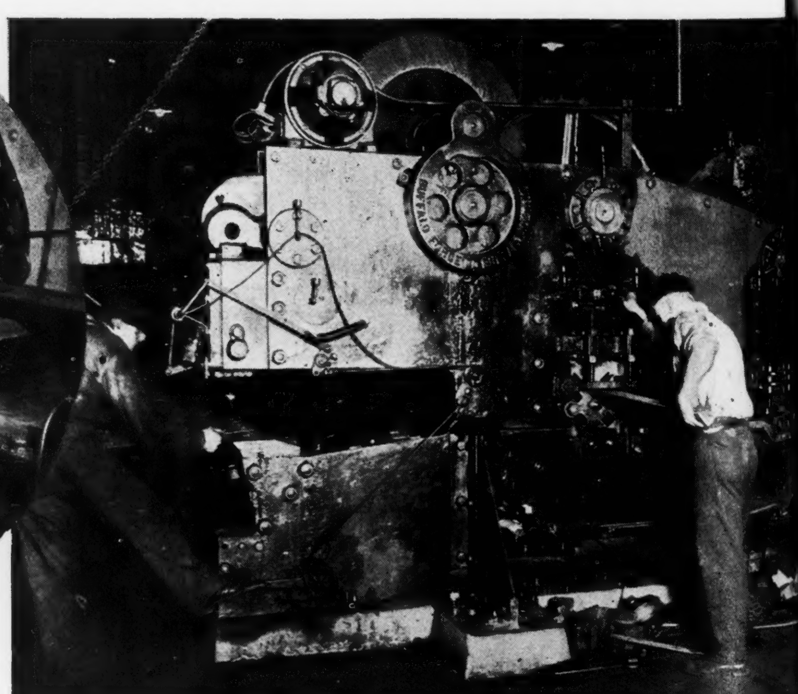
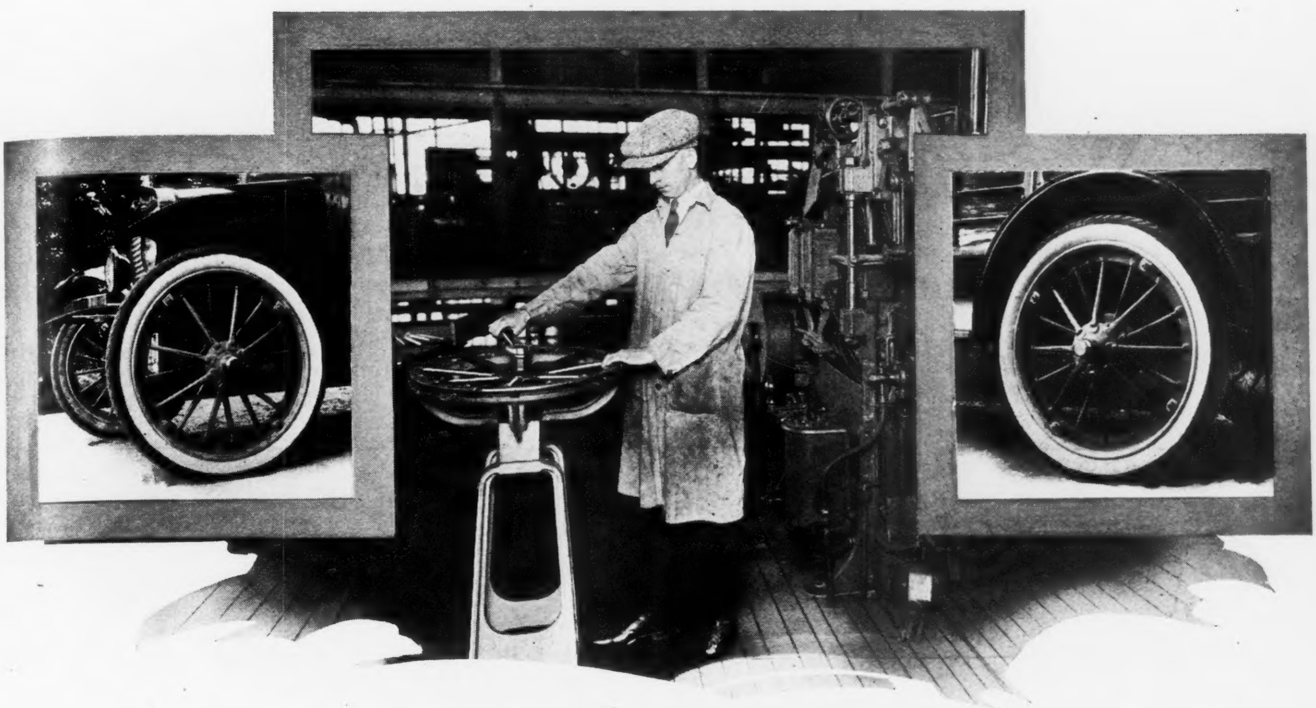
Coming in July—



While the leading article for July will deal with the design of Punching and Shearing Machinery—ably handled by Prof. A. Lewis Jenkins of the University of Cincinnati, and the first of a series which will run for several months, the diversity of other subjects featured in the reading pages will allow a wide choice for your July reading. These articles deal with many different phases of shop practice. There's one, for instance, which shows several examples of the use of steel stampings as substitutes for castings. Stampings can be much thinner than castings; they are lighter and stronger and the rapidity with which they can be made and their relatively low cost, when produced in quantities, make the subject a most important one from the manufacturer's standpoint. Their more extensive use involves changes in design in many instances and this July article will interest designers, too, because it points out some of the changes that are necessary, and why.

Not a man—executive or beginner in the field—but will be keen to follow the story unfolded under the title "Ten Years of Cooperative Education." In the little town of Springfield, Vt., there was developed and put into practice back in 1913 a cooperative educational plan for training boys in the mechanical trades simultaneously with their acquiring high school education. This plan has had a thorough tryout and has resulted





Making Welded Pressed-Steel Automobile Wheels

Methods and Equipment Employed in Making Automobile and Truck Wheels by a New Process

This article describes a new development in the manufacture of automobile wheels. It has been found that pressed-steel wheels, in which the parts are welded together, are unusually stiong and well balanced. A welded pressed-steel wheel, weighing about the same as a wood-spoked wheel, has withstood a pressure of 4100 pounds when subjected to a dish test, before signs of failure were noticed, while a wooden wheel broke at a pressure of 2200 pounds. When subjected to direct crushing tests, the wooden wheel was completely destroyed under a pressure of 6 tons, while the steel wheel only bent slightly under 9 tons. The methods used in making wheels by this process are described in the present article.

A NEW field for the use of pressed steel has been found in the manufacture of automobile wheels. Recent developments have shown that automobile wheels constructed of pressed steel, with the parts welded together, are unusually strong and well balanced, as well as attractive in appearance. The wheels here described are the product of the Stanley Steel Welded Wheel Corporation, Boston, Mass., and the success of this type of wheel from a mechanical point of view may be attributed chiefly to the welding process, by means of which the spokes, rims, and flanges are fastened together. For these operations, special welding machines of more than usual interest have been designed by Arthur M. Stanley, chief engineer of the company. Mr. Stanley has specialized in electric welding for many years, and has designed and built many of the machines now in commercial use. The machines illustrated are those built before quantity production was undertaken; machines of higher productivity are being constructed at the present time.

Construction of the Wheel

The parts forming one-half of the wheel are shown in Fig. 1, together with the outer rims. Each half consists of a spider made up of two flanges, welded together and containing eight spokes welded into pockets formed by depressions in the two flange members. Two of these spiders are butt-welded at the hub portions of adjacent flanges so that the spokes of one spider will alternate with the spokes of the other, as shown at the left in Fig. 3. This unit is then assembled into the outer rims which, as may be seen in Fig. 1, are provided with pockets into which the spokes are welded in the final assembling. The fully assembled wheel is shown at the right in Fig. 3.

There is nothing unusual in the actual press work. The two flange members, one of which has a drawn-up octagonal hub, are made from 1/8-inch stock. The two flanges that form the center of the outer spider are the same for both front and rear wheels, but the innermost flange member of the inner spider is not the same for both wheels. This is due to the necessity of providing for the brake-drum and drive on the rear axle. A machine-steel sleeve or long bushing of octagonal shape is fitted into the hub of the rear wheel. This sleeve has a tapered hole and keyway for the driving key on the axle. The flanges that are shown in Fig. 1 are for the outer spider.

The rims are also made from 1/8-inch stock, each formed so that when welded together they will form the face of the wheel and fit into the demountable rims for the tire shoe. The rims are made by bending hot-rolled angle-steel stock into a circle, joined by welding, and the spoke pockets

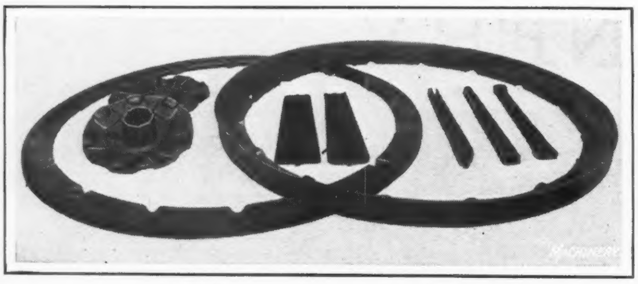


Fig. 1. Flanges, Spokes, and Rims for Pressed-steel Wheel

are formed in a press. The spokes are made from 1/16-inch stock in five operations, exclusive of welding. The appearance of the work after each operation is indicated in Fig. 1. The tapered spoke blanks are formed on the edge, partly closed, then entirely closed, welded at the seam, and finally flattened at the ends to fit the pockets in the wheel rim.

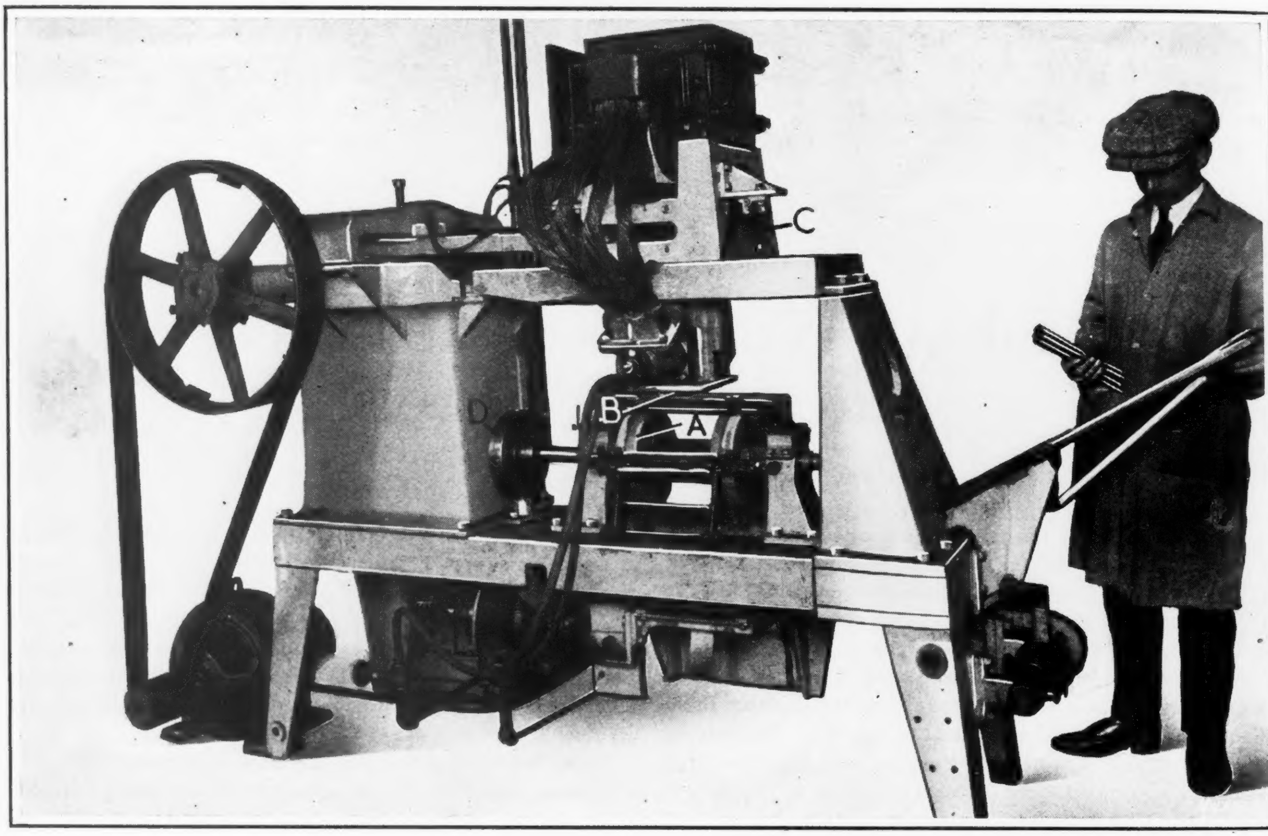


Fig. 2. Butt-welding Machine on which the Spokes are welded at the Seam

Two views of the spoke-welding machine are shown in Figs. 2 and 4. The machine is motor-driven, with automatic electric control for the welding current. There is an indexing work-holder *A*, which passes the spokes under the welding roll located at *B*, while the carriage *C*, which carries the roll, slides back and forth on the top rail of the machine. The carriage also supports a transformer for stepping down the current from 550 volts, 70 amperes to 4 volts at about 10,000 amperes, which is suitable for butt-welding. There are circuit breakers on the carriage at each end so that at the extremity of each traverse, while the welding roll is off the work, no current flows. Then with the mechanical return of the slide, electric current is passed through one side of the two-part roll into the work (which is now pressed together at the seam) and back through the other side of the roll, completing the weld at the end of the stroke.

Suitable adjustments are provided for regulating the amount of pressure for the welding roll. The roll consists of two copper disk-like parts, separated 1/16 inch and formed on the face to the contour of the spoke along the seam. A water pipe delivers circulating water to the rolls to prevent them from becoming overheated. The indexing movement of the work-holder is controlled by a four-notch Geneva gear, so that at each 90-degree revolution a spring plunger engages a hole in the index-wheel *D*, which is fastened to the work-holder shaft, and holds it while the welding rolls are making one pass over the work.

Method of Holding the Spokes while Welding

The formed spokes are fed by hand into a chute, whence they are deposited on a slide located beneath the work-holder. From here they are transferred into a carrier which moves vertically to lift each spoke and deposit it in the work-holder. Each station on the work-holder carries two spring clamps, which are operated by coming in contact with posts on the carrier as it holds the spokes up in position to be picked up by the work-holder. These spring clamps engage the work from each end and release it after the weld has been completed, so that with the next 90-degree movement the spoke is free to fall from its cradle-like support and drop into a receptacle on the floor. Fig. 2 shows the work-holder about to deliver a spoke into this receptacle.

The shaft from which the slide and work-carrier are operated by means of links and eccentric cams is situated on the right-hand side of the machine, as indicated at *E* in Fig. 4.

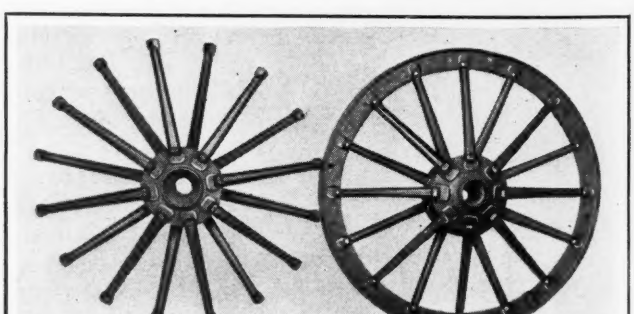


Fig. 3. Wheel before and after Rims are assembled

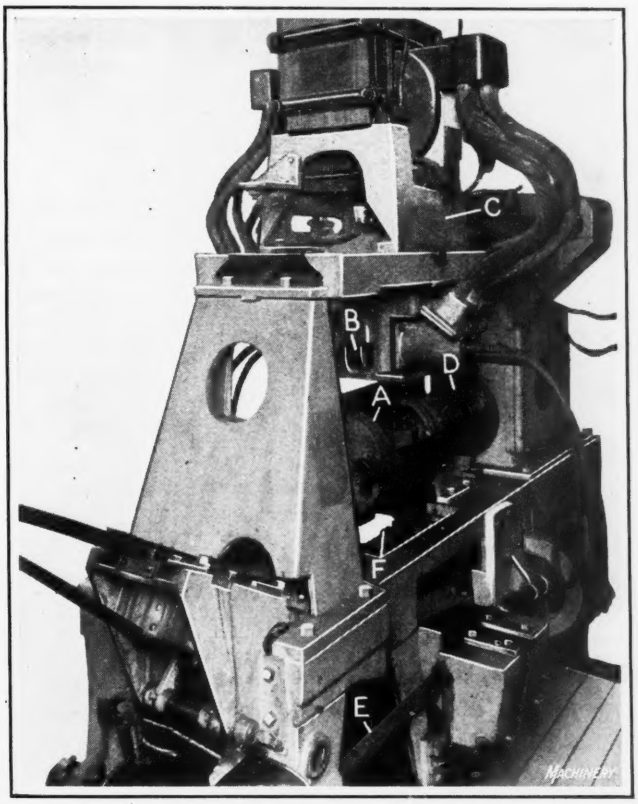


Fig. 4. Machine shown in Fig. 2 seen from the Opposite Side

The view from this side of the machine gives an idea of the arrangement for delivering the spokes to the work-holder. A spoke may be seen at *F* as it rests in the carrier before being raised to the work-holder. One of the posts for operating the spring clamps by means of which the spokes are held is also visible.

The time required for the welding rolls to pass over the work and complete a weld is three seconds. The proper regulation of electric current and mechanical pressure makes it possible to weld the spokes without producing any flash at the joint which would involve subsequent labor in cleaning the weld.

Making the Spiders

The equipment for making the spiders consists of an assembling stand and a spot-welding machine, as illustrated in Fig. 7. This stand is used in assembling the spokes in the central flanges prior to welding, and also, in another operation, in assembling the rims after the spiders have been made. The spot-welding machine is also used for welding the rims, with suitable changes of electrodes and work-supports.

In making the spiders, a handwheel on the stand is adjusted to bring its hollow spindle to the correct vertical height, and then an arbor is fitted into the hollow spindle and prevented from turning by a spline. The outer flange member is next slipped over the arbor, and a rim fixture laid on the stand. This fixture is a replica of the rim itself, and has pockets so that the spokes may be laid in and clamped in position. For this purpose, four spring clamps are used near the periphery and a nut on the central arbor is tightened up with a wrench. This entire assembly is then lifted from the stand and transferred to the welding machine, where it is placed on the work-holder *A* which may be slid in or out on rods as required. The work-holder has provision for receiving the arbor on which the assembly is secured, and holding it in at the dish angle of the wheel when the outer spider is being welded, or vertically for the inner spider.

The flanges are first welded through the spokes and then between them, the radius of the circle for each series of welds being slightly different, so that stops on the work-holder may be swung horizontally to locate the center of the assembly correctly with reference to the electrodes. The stops are indicated at *B* and the electrodes at *C*. A spring sleeve in the work-holder permits the assembly to yield under the welding pressure, so that when the work is held between the pressure of the two electrodes, it will not be rigid but capable of readjusting itself without producing stress in any part. At the completion of each weld, the spider is lifted by the spring sleeve so that it may be indexed and readily removed from the arbor at the end of the operation. The indexing is done by a ratchet wheel with which a spring index-pin engages at each one-eighth revolution.

Operation of the Spot-welding Machine

The automatic machine for spot-welding the wheels deserves special mention. The upper electrode-holder is held in a frame that pivots to exert pressure on the weld, this pressure being automatically controlled by cam action. The

Fig. 5. Spot-welding the Rims on an Electrically Controlled Machine

Fig. 6. Butt-welding the Two Spiders at the Hub

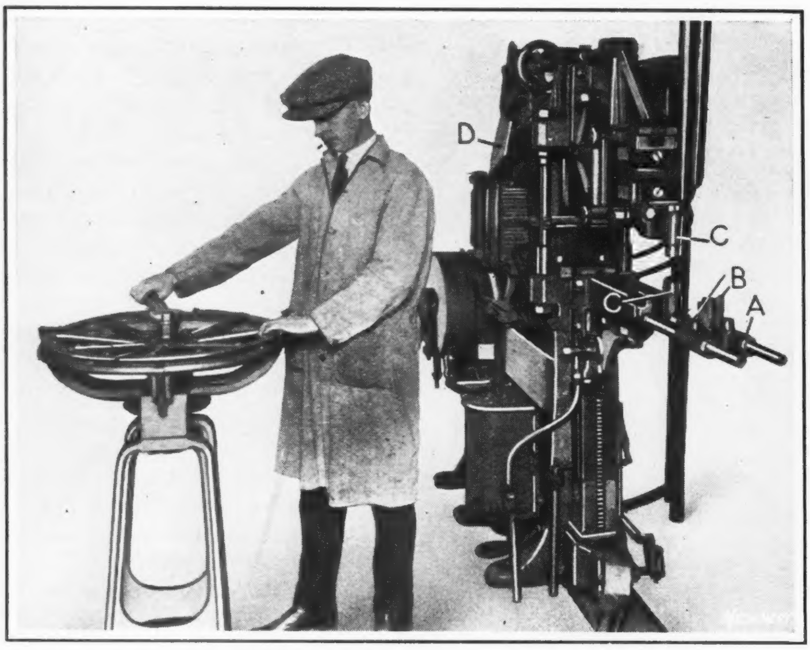


Fig. 7. Floor Stand and Spot-welding Machine used in assembling Spokes in Flanges and Rims

shaft *A*, Fig. 5, by means of which the pressure is transmitted, carries a heavy coil spring and a handwheel for setting the pressure. The spring is capable of transmitting 600 pounds pressure, and the arrangement for adjusting it is such that foot pressure is not required on the treadle. By simply tripping the foot-treadle, a clutch is engaged on the driving gear, which results in the pressure being automatically applied. The welding head is heavy and has considerable overhang; to compensate for this, heavy weights are hung on both sides of the machine, the one at the left being shown at *D*, Fig. 7. The electrodes are connected with a water line to prevent them from becoming overheated.

The entire cycle of operations in making a spot-weld includes depressing the electrode, holding it down under pressure for a given time, switching on the current, breaking the current, and finally releasing the pressure. On the right-hand side of the machine at *B*, Fig. 5, may be seen the rheostat for cutting out the resistance on the transformer and thus controlling the amount of current at the weld; this is necessary on account of the variation in the composition and thickness of metal. The controller for the current supply is located on the left-hand side of the machine.

The lighting circuit operates a remote control system, the breaker for which is located above the machine on a post, while the switch for opening and closing the lighting circuit is controlled by mechanical means when the foot-lever is operated. A 550-volt current of 100 amperes flows to the transformer, where it is stepped down to 4 volts 13,750 amperes. The time required to make one spot-weld is one second.

Butt-welding the Spiders

After the spokes have been spot-welded through the flanges, two spiders, one outer and one inner, are butt-welded on the special machine illustrated in Figs. 6 and 8. The spiders are chucked on octagonal expanding electrodes, made of copper. The flats on these electrodes are so located that the spokes on opposed spiders alternate in the manner indicated in the illustrations. The levers *A* and *B* operate the draw-in arrangements for expanding the electrodes.

The large handwheel, by means of which the movable spindle *C*, Fig. 8, is operated, is geared to a rack on the spindle by planetary gearing, so that after the operator has brought the two spider hubs together he can continue to turn it, to compress the heavy car spring *D*. Turning the handwheel also operates a ratchet, so that when the spring is compressed under about 2000 pounds pressure, the pawl and ratchet lock the handwheel and hold the spring in compression.

The current is then switched on by means of the push-button switch *E*, and soon the metal at the abutted ends of the hubs becomes plastic under the extreme heat. The pressure of the compressed spring will force the spider on the movable spindle toward the stationary spider about 1/16 inch, or until it is stopped by an adjustable collar on the end of the spindle. This movement operates a circuit breaker and shuts off the current. By this means the amount of pressure, determined by the fluidity of the hot metal, indicates when the weld has been correctly made. Uniform results are thus obtained and no excessive flash produced where the hubs are joined.

After the weld has been completed, there is a tendency for the operator to attempt to withdraw the movable spindle before it has released the work, which, of course, would tend to pull the still hot welded joint apart. A safety device is used to prevent this, which requires that the operator trip a foot-treadle. This treadle is connected to a bell-crank lever by a rod *F*, and the bell-crank is connected by rod *G* to lever *B*, which controls the expanding electrode. Tripping the treadle releases the ratchet lock for the compressed spring at the same time that lever *B* is operated to contract the electrode chuck. The spindle is then readily withdrawn, leaving the welded spiders on the stationary electrode. The other lever *A* is next operated to release the work.

In making a weld, the sequence of operations is as follows: The operator first chucks the two spiders, and then turns the handwheel until the heavy coil spring is compressed. He then pushes the switch and holds the push-button in until the weld is finished, which requires about three seconds, during which time the 1/16 inch movement of the mov-

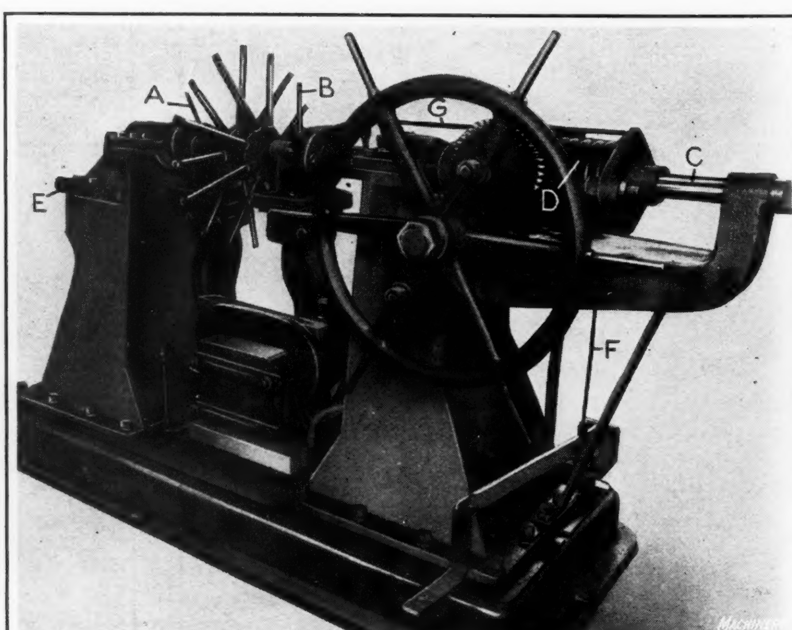


Fig. 8. Another View of Butt-welding Machine shown in Fig. 6

able spindle occurs. As soon as the spindle is stopped by the collar at the end, the current is released, and the foot-treadle depressed to disengage the ratchet and at the same time contract the movable electrode. The handwheel is then turned back, withdrawing the electrode from the hub of the wheel.

The heads that carry the two electrodes are made interchangeable for different diameters of wheels, and suitable longitudinal adjustments are also provided for both spindles. The same current and voltage is used as for welding the spokes, that is, 4 volts 10,000 amperes, stepped down from a 550-volt current supply.

Spot-welding the Rims

The final assembling operation in making the pressed-steel wheel consists of assembling two rims to the butt-welded spiders, and the stand shown in Fig. 7 is again employed for this purpose. The handwheel is adjusted to bring the hollow spindle in which the arbor fits to the proper height, the welded spiders are placed on the arbor, and the rims laid in place and clamped. This assembly is then transferred to the spot-welding machine, which has accommodation for a suitable work-holder of the same type as that used in welding the flanges.

The operation of welding the rims is illustrated in Fig. 5. One weld is made through each of the sixteen spokes and two between them, making a total of forty-eight welds around the rim. There is a nub on the end of the upper electrode, offset from the center, and this projection extends sufficiently to permit the end of the electrode to pass over the bulge on the spoke just about where it is flattened. (See Fig. 3). The nub is first located so as to weld spots through the flattened ends of the spokes; it is then turned around to shorten the distance to the wheel center for welding between the spokes. The same length of time is required for welding the rims as for welding the flanges—one second per spot. The last step in the production of the finished wheels is dipping them in gloss paint and baking.

Comparison between Welded Pressed-steel and Wood-spoked Wheels

Pressed-steel automobile wheels weigh about the same as wood-spoked wheels. Tests have recently been conducted to determine the relative strength of wood and pressed-steel wheels. In these tests, the wheels were held on an arbor, and subjected to a dish test; that is, pressure was applied axially until failure occurred. The wood wheel broke at an applied pressure of 2200 pounds, while the pressed-steel wheel withstood a pressure of 4100 pounds before signs of failure were noticed. At this pressure the wheel became distorted, but did not break.

Under direct crushing tests, the wooden wheel was completely destroyed at a six-ton pressure, while the steel wheel bent slightly at nine tons. These wheels have been on the road since May, 1922, and it is claimed that the owners have found them very satisfactory, giving easier riding qualities to the car. The inventor attributes this to the fact that the wheels, having members both in tension and compression, have greater resiliency and shock-absorbing qualities. Some of the wheels have been in bad accidents where side skidding occurred, which would doubtless have broken wooden wheels and might have damaged the car, whereas these wheels have stood the shock without damage to either the wheels or the machine. Another claim for this wheel is greater life of the tire. The inventor has used a car with these wheels, driving 10,500 miles over all kinds of roads and under widely varying conditions. Fabric tires have been used, and the rubber appears today to be as live as when the tires were put on. The longer life of the tire is believed to be due to the fact that the pressed-steel wheel possesses greater heat conductivity, and as a result, the heat of the tire is reduced.

GAGE FOR SPRINKLER-HEAD BAR

A gage having a ball-bearing slide and dial indicator is used for inspecting bars on trigger-pieces used in sprinkler heads for fire extinguisher systems. The bar is made of a brass composition consisting of 66 per cent copper and 33 per cent zinc. Fig. 1 shows the construction of the trigger mechanism. It will be seen that the bar is supported by a post, the two being braced by a strut soldered in place, which collapses at a predetermined temperature to operate the sprinkler head. In assembling the sprinkler head, a pressure of 1000 pounds is applied through the medium of the screw, and it is necessary that this pressure be determined by a definite number of turns of the screw. By carefully checking the distance between the screw and post, as indicated in Fig. 1, it is possible to maintain uniform results; if this is not done, the leverage produced by a given number of turns of the screw will vary in proportion to the error.

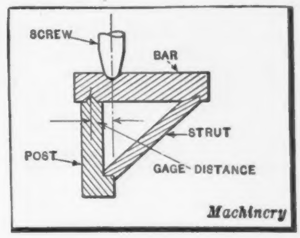


Fig. 1. Distance checked by Gage shown in Fig. 2

Method of Inspecting the Bar

The point of the screw fits in a cast hole in the top of the bar, and the post has a lug which fits into a groove cast crosswise in the bar. It is the distance between this groove on one side and the hole on the other that is checked by the gage shown in Fig. 2. The gage has a ball-bearing slide *A* carrying a post, the tapered end of which is of the same dimensions as the end of the screw in the sprinkler-head. The bar is supported by this post and by an upright at the rear, in which position it is held by means of the spring lever shown.

The standard in which the spring lever pivots carries a pawl *B*, which, after the bar has been located, is swung down until it engages the groove in the bar. It is pressed against the bar until the pin *C* can be passed through to locate it. The bar now occupies the same position relative

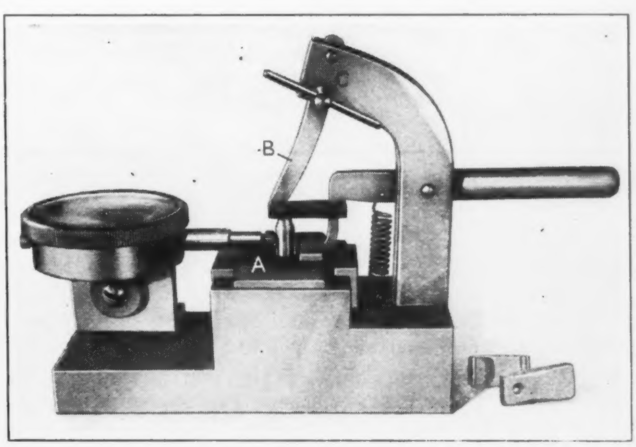


Fig. 2. Use of Gage for inspecting Sprinkler-head Bars

to the gaging points of the gage that it does to the post and screw in the assembly.

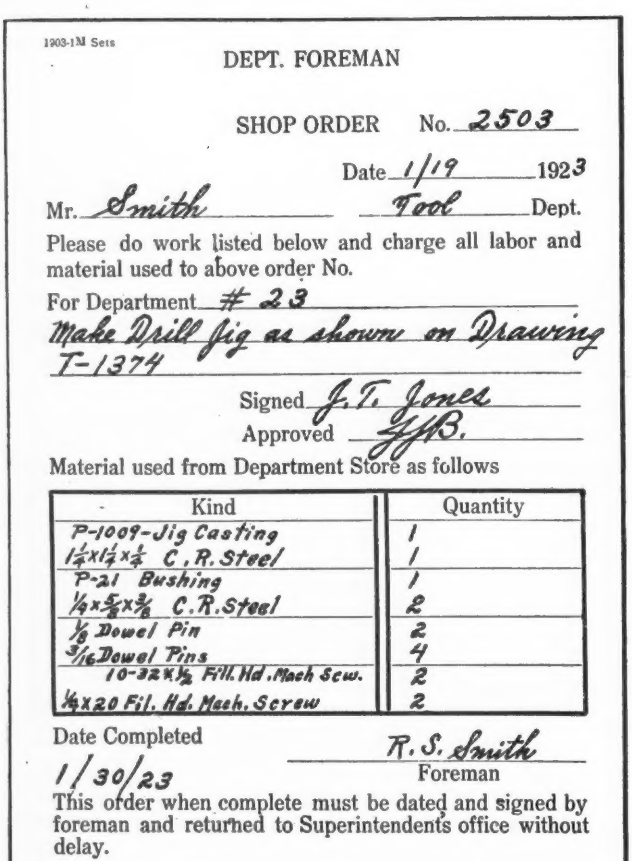
Pressing the pawl *B* into the groove to locate it correctly, may cause a movement of the slide that carries the vertical post, which will register on the dial gage any error that exists between the two gaging points. It will be noticed that the post extends through a bridge piece which has an elongated hole to permit this movement. The slide, being supported on ball bearings, will respond to any slight pressure produced in locating the bar in the position shown, and any resulting movement of the post will be registered on the dial of the gage.

TOOL-ROOM DRAWINGS

By JOHN J. BORKENHAGEN

The method of handling a tool-room job in one of the largest factories in Chicago is described in the following. When a new jig or fixture is designed by the engineering department, a detailed drawing and a shop order slip such as shown in Fig. 1 are sent to the tool-room foreman. On receiving these, the foreman makes up a sketch, which shows the work in its proper position in the jig or fixture. For clearness, the part is colored with red crayon.

On this sketch the foreman writes out a complete list of the materials required for the job and a list of the machining operations. The sketch and the shop order are next forwarded to the man in charge of the tool-crib, who obtains the parts and materials called for. The materials, sketch,


1903-1M Sets

DEPT. FOREMAN

SHOP ORDER No. 2503

Date 1/19 1923

Mr. Smith Tool Dept.

Please do work listed below and charge all labor and material used to above order No.

For Department #23

Make Drill Jig as shown on Drawing T-1374

Signed J. T. Jones

Approved J.J.B.

Material used from Department Store as follows

Kind	Quantity
P-1009-Jig Casting	1
1¼x1¼x¼ C.R. Steel	1
P-21 Bushing	1
¼x⅝x⅜ C.R. Steel	2
⅛ Dowel Pin	2
3/16 Dowel Pins	4
10-32x½ Fill. Hd. Mach Scw.	2
¼x20 Fil. Hd. Mach. Screw	2

Date Completed 1/30/23

R. S. Smith
Foreman

This order when complete must be dated and signed by foreman and returned to Superintendent's office without delay.

Fig. 1. Shop Order Blank issued with Detail Drawing shown in Fig. 2

and shop order are then placed in a pan and sent back to the foreman, who assigns the job to one of the toolmakers.

When the fixture is finished, the date of completion is added to the shop order, and one copy of the latter is sent to the production department, where a record is made that the job has been completed. From this department the shop order is forwarded to the cost department, where the cost of the materials is added to the labor cost. Two carbon copies of the shop order slip are made, one being retained as a production department record, while the other is sent to the cost department. The original slip is delivered with the finished jig.

Records of all the time spent on the job are sent to the cost department on the regular time cards and charged to the order number written on the shop order slip. In Fig. 2 is shown the drawing of a part for which a drill jig is to be made. The hub A is previously turned between centers on a lathe to a diameter of 1 inch. The jig is required to locate and hold the work for drilling the 0.249-inch hole.

The working sketch made by the tool-room foreman is shown in Fig. 3. In the original sketch, the starting lever A which is to be drilled is shown in red dot-and-dash lines,

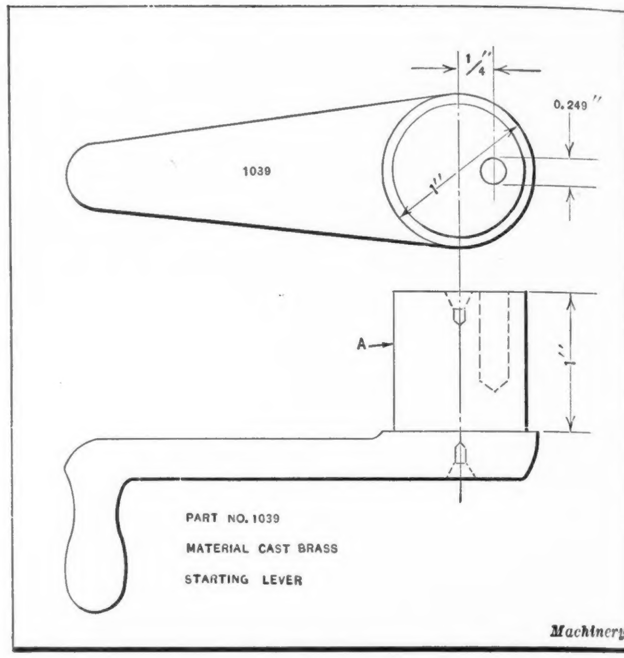


Fig. 2. Detail Drawing of Starting Lever for which Drill Jig is to be made

and the fixture in black lines. That part of the starting lever cross-sectioned in dot-and-dash lines is colored red. In addition to the dimensions shown in Fig. 3, the complete sketch gives full specifications for each part and a list of the machining operations required.

* * *

The eleventh annual meeting of the U. S. Chamber of Commerce was held at the Waldorf-Astoria Hotel, May 8 to 11. Among the subjects of interest to the machine-building industries were immigration and labor needs; fabricated production; transportation; and the influence of European conditions on American business.

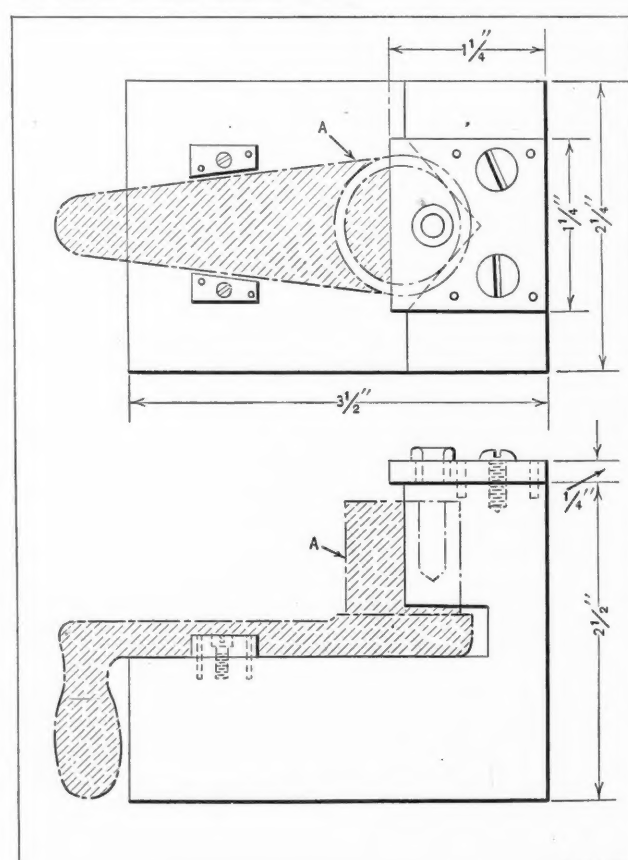


Fig. 3. Sketch used as Working Drawing in Tool-room

Work-holding Surfaces of Machine Tools

Table Design for Different Types of Machines—Third of Three Articles

By FRED HORNER

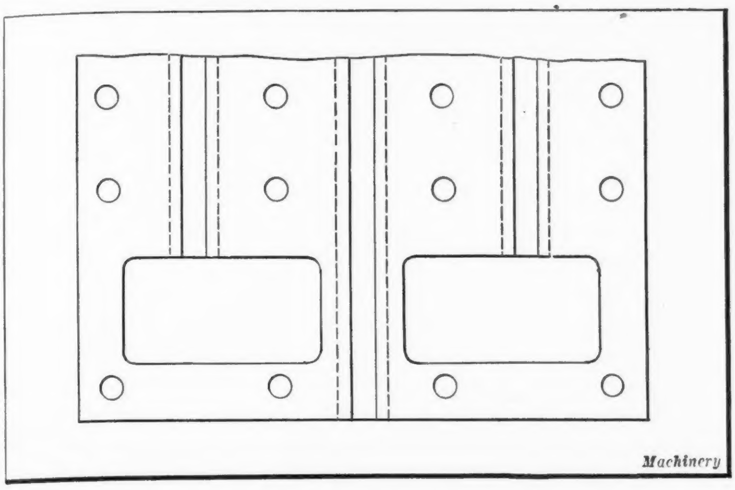


Fig. 18. Table machined flush around the Drainage Pockets to increase the Work-holding Area

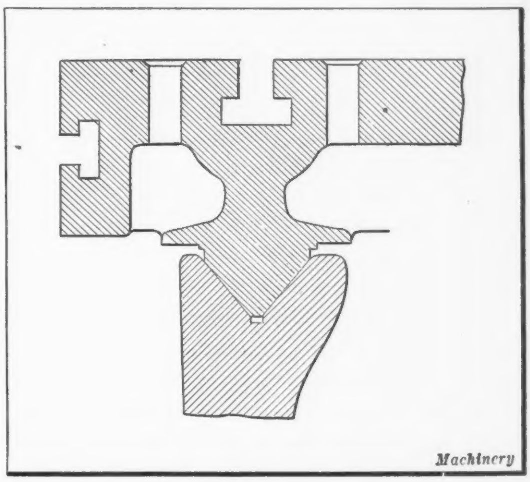


Fig. 19. Table Design in which Overhanging Lips protect the Ways of the Bed

In the first and second installments of this article which appeared in April and May MACHINERY, the provisions made on machine tool tables for clamping the work, jigs, and fixtures thereto, and lubricant drainage methods were discussed. The present and concluding installment will illustrate and describe other interesting table designs. While for general purposes there is an absolute necessity for having the table of a milling machine flush all over, this is not so with some manufacturing types of machines which have the size of work restricted within definite limits and do not require attachments that overhang the table area. In such a case a raised oil-pan rim can be cast around the table extending to a height of two or more inches above it. An alternative to such construction consists of sheet strips, clamped or hooked to the table or a steel pan surrounding it.

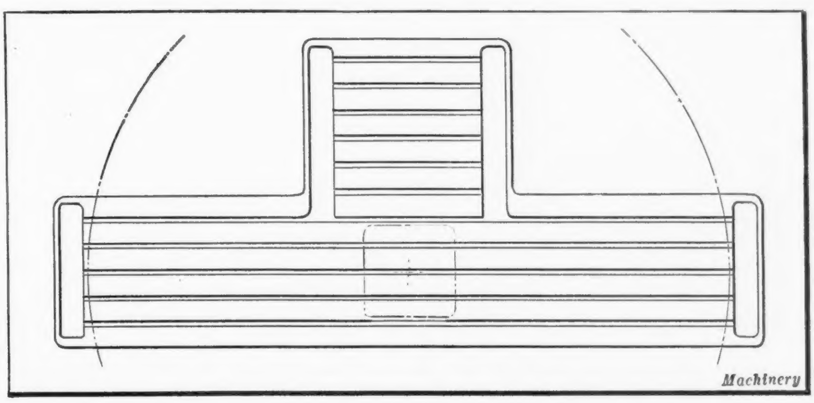


Fig. 20. Conveniently arranged Three-arm Base for a Radial Drilling Machine

The tendency toward extension of the bolting surface is noticeable in planer design. Many planers have the middle T-slot carried right through to the end of the table and have bosses cast to contain stop-plug holes. This enables the table to receive longer pieces than an ordinary one on which the pockets alone overhang. An advantageous design is a table machined all over to supply means of support, as represented in Fig. 18. A little detail of table construction concerns whether the plug holes should be drilled through or only partly so. If the latter practice is followed, the holes become a nuisance by filling up, and in the former case, there is risk of dirt and chips falling

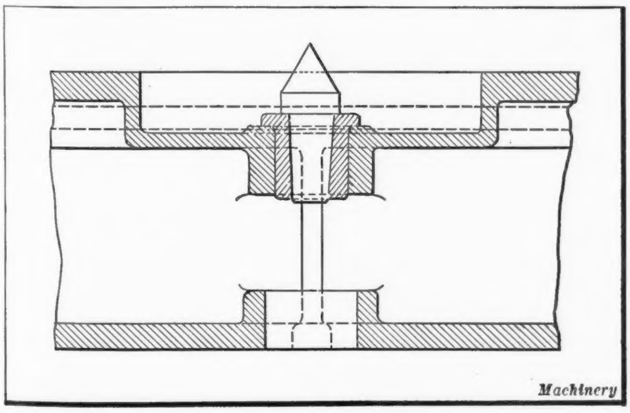


Fig. 21. Center provided on Heavy Vertical Boring Machines for supporting the Lower End of the Boring-bar

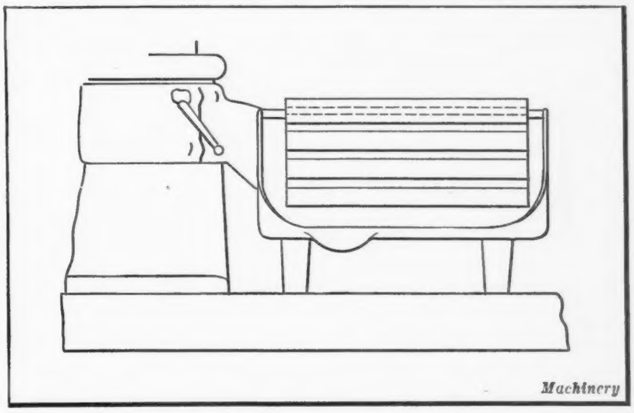


Fig. 22. Angle Table that swings on the Column of a Drilling Machine, and has Legs extending to the Base

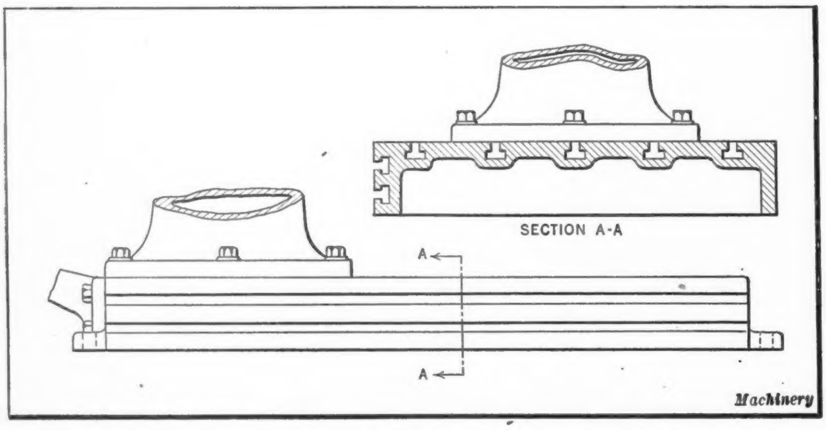


Fig. 23. Machine Base provided with T-slots on Vertical Face in Addition to those on the Top Surface

through on the ways of the bed. The casting of ledges on the under side of the table, as illustrated in Fig. 19, obviates this trouble. This provision is unnecessary with box tables, because the entire bottom side of the table is closed.

T-slotted Machine Bases

The bases or floor-plates which certain kinds of machines require are varied in their shape and in the arrangement of the T-slots. The shape depends on the form of the work and the movements of the tool above. Whether there happens to be a supplementary table or tables also affects the design of the base. The plainest patterns are rectangular plates having longitudinal slots only, or others set at right angles as well. The latter type is better for the rapid transposing of bolts about the surface, and is particularly useful when brackets, heads, etc., must be mounted on the plate,

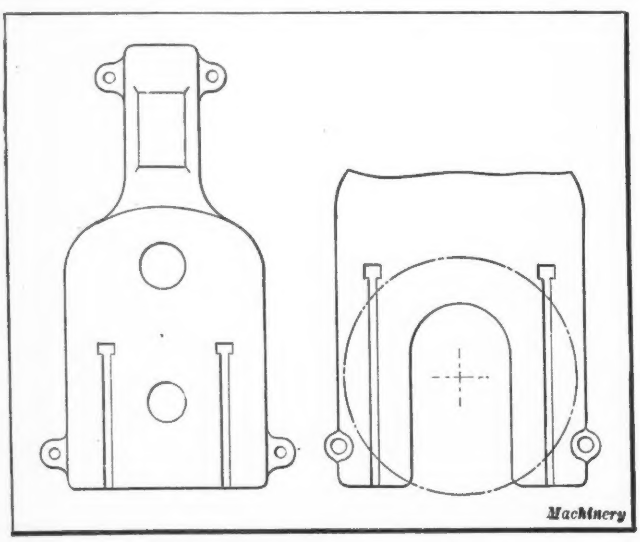


Fig. 24. Two Suitable Styles of Base for Drilling Machines not provided with Radial Swing

as well as the work, as in the case of horizontal boring machines.

Plates of other than plain rectangular outline occur when the tool is carried at one corner or on an angle, or when it swings through a definite portion of a circle. Radial drilling machines may, as a case in point, embody a right-angle base, one arm of the base being utilized for bulky castings, and the other mostly for the reception of a box or swivel table. This principle saves time, because objects may be set up on one section of the base while drilling is being done at the other, and so the working time of the machine is practically continuous. A still better lay-out comprises three arms, as shown in Fig. 20, where the location of the column and the range of the spindle path are indicated by dot-and-dash lines. The work is bolted down on the areas to the right and left, and a box table can be used on the shorter section at the front. The relative proportions of the sections naturally depend on the class of work to be handled, and perhaps a longer extension may be required at the front. Fig. 23 illustrates a deep base with two T-slots on one side; these are a handy addition for clamping some shapes without the use of angle-plates or awkward blocking.

The bases for upright drilling machines without radial swing are either cast as continuous plates with provision at the rear for the attachment of the column, or are formed with projecting feet. Both styles are shown in Fig. 24. The one at the left is an unbroken plate with T-slots and a center hole for

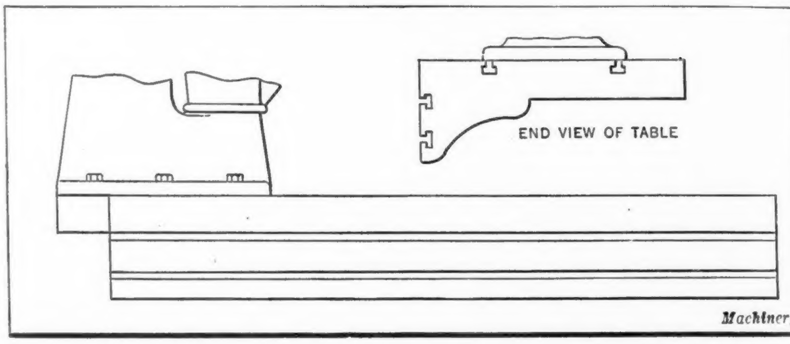


Fig. 25. Angle Table provided with Long T-slots on a Vertical Face to facilitate holding a Number of Parts at One Time

bushings. The number of slots may be increased on the feet at the right to two, or even three when the feet are wide. Bushing holes are common in many machine bases.

A fitting frequently applied to heavy vertical cylinder-boring machines is a center of the style shown in Fig. 21, which is used to support the bottom end of the boring-bar. A feature that must be mentioned in relation to bases concerns the methods of quantity production in plants where drilling operations are performed on automobile and other castings, held in cradles or jigs. The usual base is abolished in so far as using it for a clamping surface is concerned, and the jigs travel from one machine to another on wheels running on tracks laid in front of the machine.

Angle and Box Tables

For drilling, boring, shaping, and sawing operations, angle and box tables are particularly valuable. An angle table has the top and one side slotted, while a box table has at least three faces machined for the attachment of work. Either table may be a permanent fixture on the machine column or base, or facility for quick displacement may be

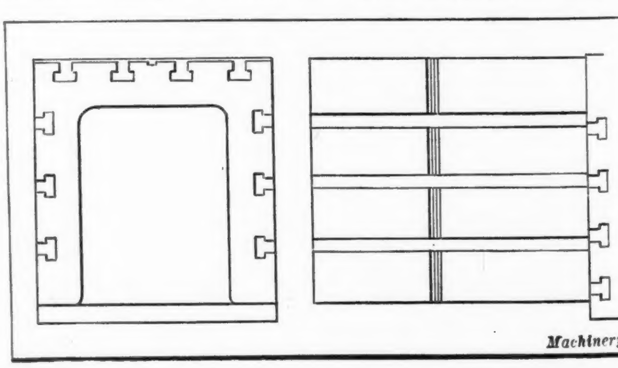


Fig. 26. Simple Form of Box Table used on Shapers, provided with Special Grooves for holding Cylindrical Parts

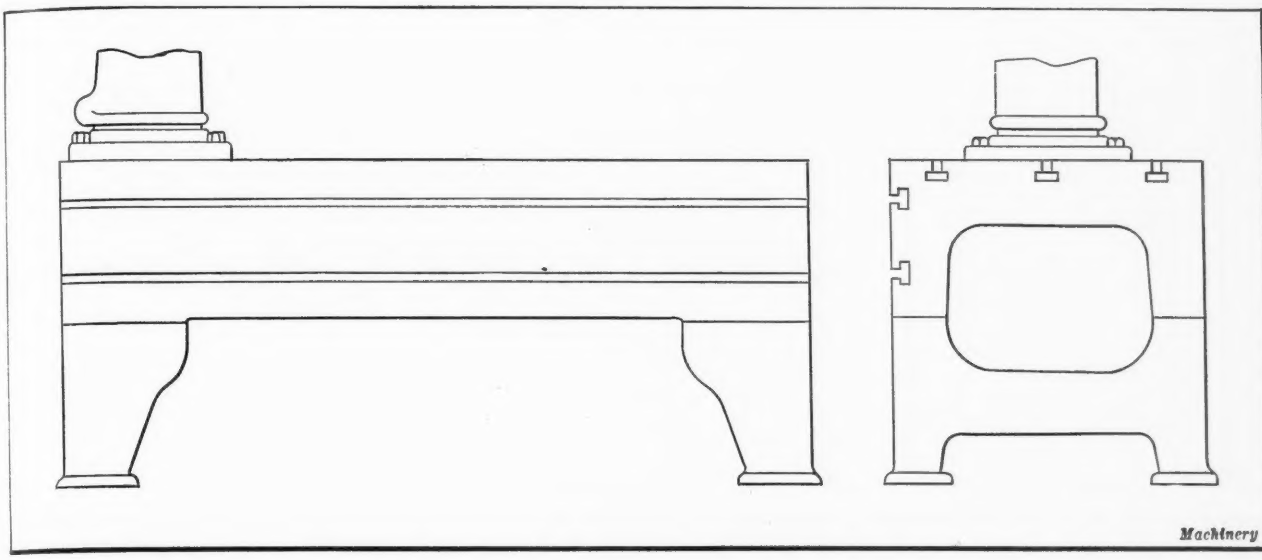


Fig. 27. Drilling Machine Table which is a Compromise between the Angle and Box Types, T-slots being provided only on the Top Surface and on One Vertical Face

provided. The box type probably holds the preference, partly because it is better balanced, and partly because a second vertical face is available for the attachment of special fittings or the setting up of work on one side while an operation is proceeding on work held on the opposite face.

The angle table exists in greatest numbers on drilling machines and small shapers. Sufficient room for the holding of much work to be drilled is afforded by providing T-slots of the length shown in Fig. 25; this view does not show the table supporting legs. Shaper tables differ from this in the proportion of the length to the depth, and in the fact that the bolt slots on the top may run transversely. The slots in the vertical face sometimes lie vertically, but they are then open to the objection that the bolts slip down when loose. The addition of one or two vertical V-grooves would add to the value of the face for clamping round pieces in upright positions.

Many angle tables are arranged with bearings so as to swing around the column of a drilling

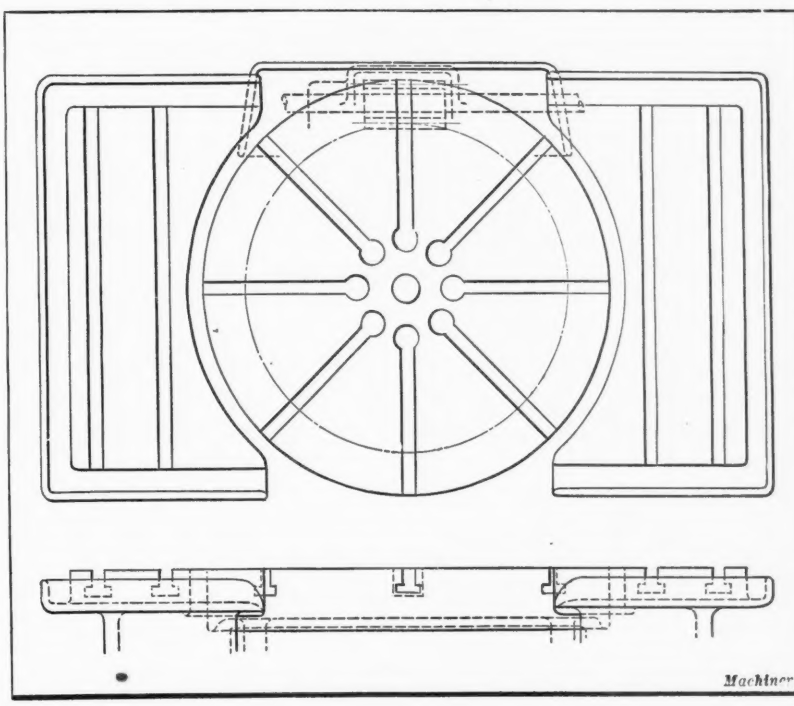


Fig. 28. Sectional Design of Table consisting of a Rotary Circular Table flanked by Two Sections that enable Work to be mounted for Longitudinal Machining

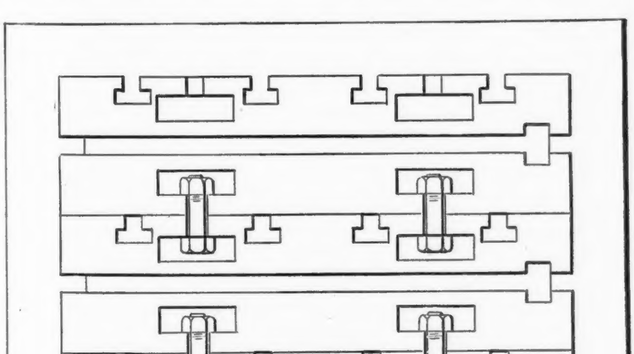


Fig. 29. Built-up Box Table of the Type furnished on Cold-saw Cutting-off Machines for raising the Work to suit the Height of the Saw

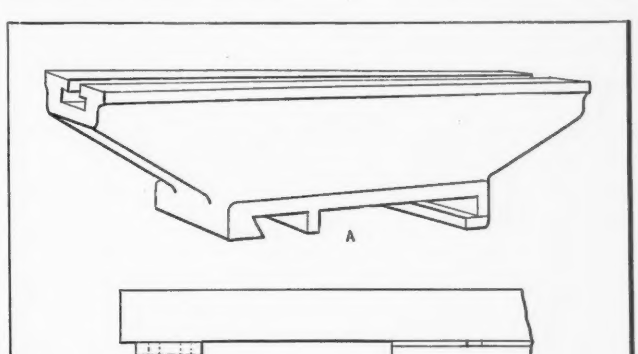


Fig. 30. (A) Casting used on Boring Machine Tables to provide Supplementary Support; (B) Use of a Supplementary Plate mounted on a Vee in Front of the Table

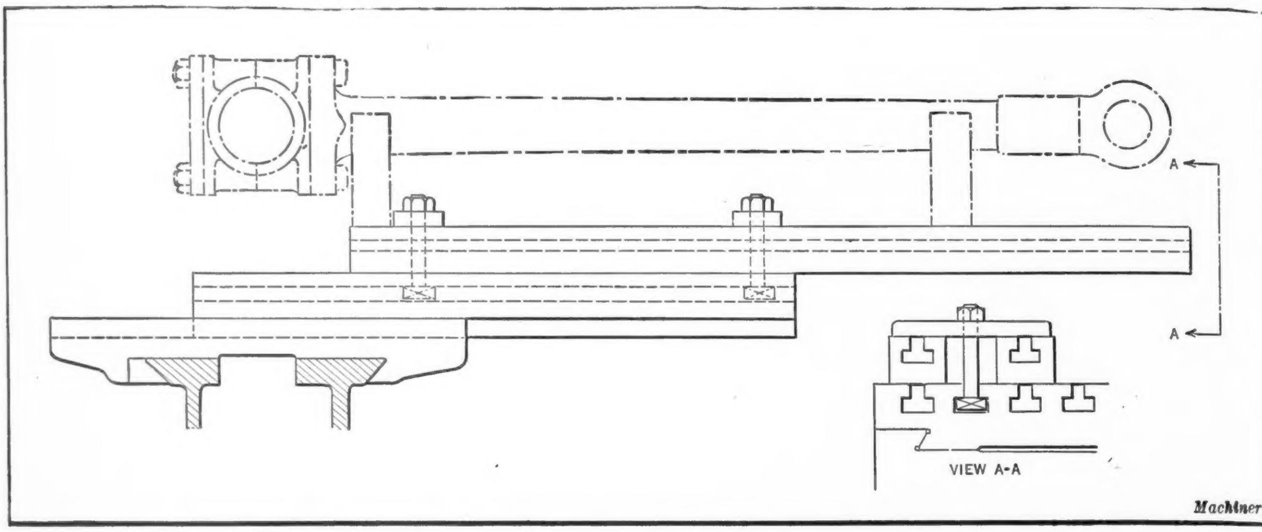


Fig. 31. Method of securing Long Connecting-rods on a Table by the Use of Simple T-slotted Bars and V-blocks secured to the Bars

machine, or around a separate pin adjacent to the column. Feet are cast on to bring the table into contact with the baseplate, as illustrated in Fig. 22; this illustration shows a rim cast all around the table edges to catch coolant and lead it into a sump at a lower point where a hole is provided for a drain-cock or pipe connection. The independent construction of such a table simply involves the casting of a strong column and a foot to rest on the baseplate. A swivel action is often added to provide a range of movement of 90 degrees.

The simplest form of box table is that usually adopted for shapers, and in Fig. 26 is shown a style that may be supplied with special grooves for the holding of cylindrical work, location of special attachments, circular arbors, etc. An increased holding capacity can be obtained on the top by casting the table farther out at the front as an overhanging ledge, or by bolting a supplementary table of larger area across the top. The T-slotted face of the saddle, which is invaluable for clamping heavy pieces, is carried far down in the more massive machines and even into a pit extending the length of the frame. Many set-ups are possible with these saddles when they exist in pairs. Long castings may also be supported in numerous ways between two box tables. In order to sustain the weights of very large castings, angle-brackets or stop-blocks are frequently employed against the vertical faces of the table.

Fig. 27 offers a sort of compromise between an angle and a full box table, the drilling service demanding slots only on the top and front face. For boring machines, as well as some drilling machines, a full box table, that is, one with slots on every side, is occasionally useful, though generally the requirements are satisfied if the bottom is left unslotted and used only for bolting to the baseplate by means of flanges. Heavy tables applied to cold-saw cutting-off ma-

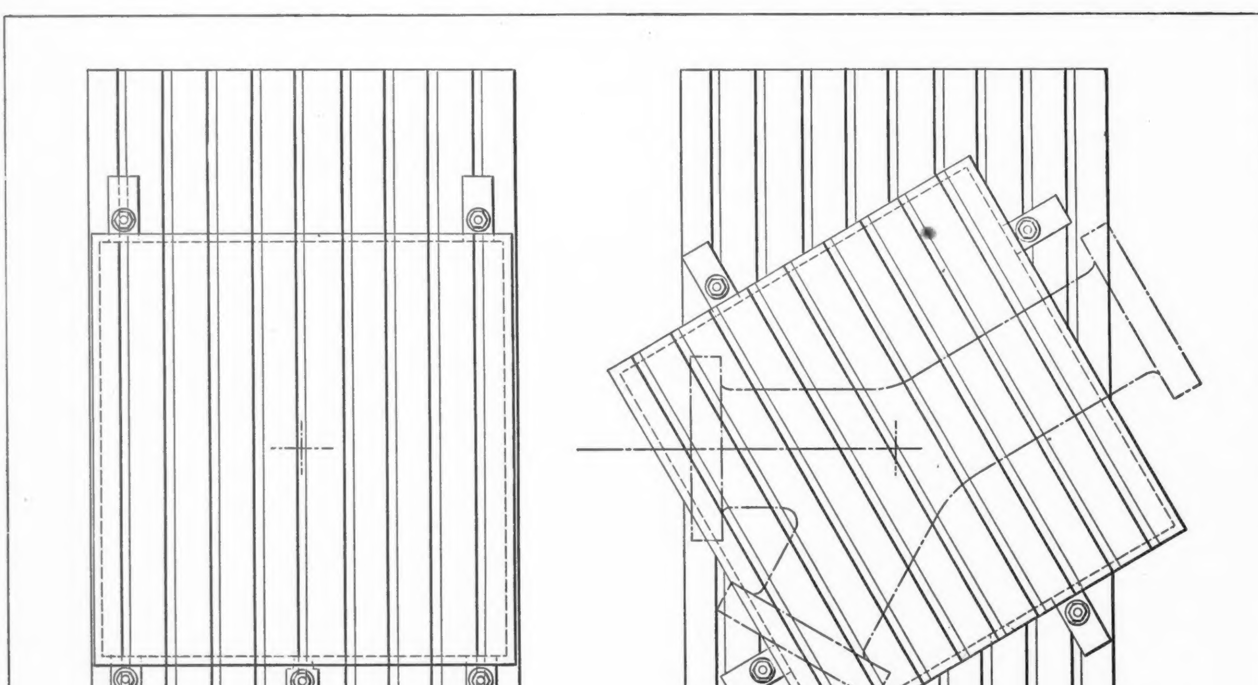


Fig. 32. Diagrammatic Views, showing the Positions in which a Quartering Table or Turntable may be employed

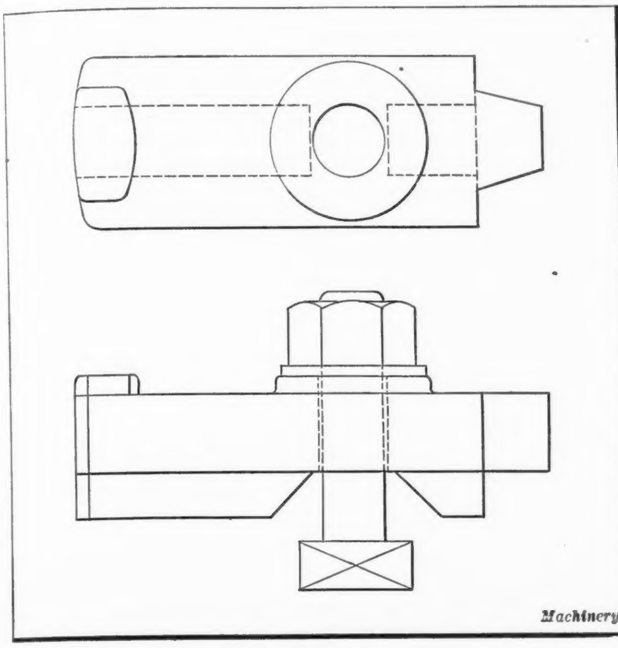


Fig. 33. Detail View of the Quartering Stop used on the Supplementary Table illustrated in Fig. 32

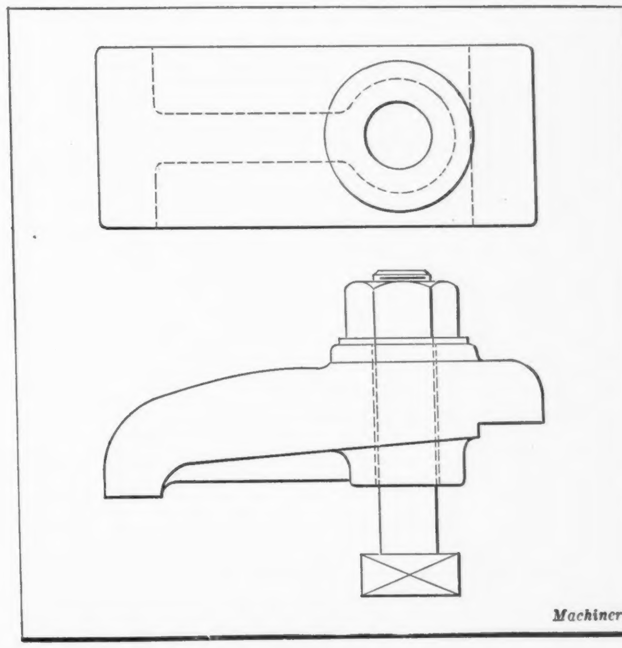


Fig. 34. Detail of the Clamps used in securing the Quartering Table to the Regular Table of the Machine

chines are generally adjustable without a screw or rack-and-pinion mechanism, the device commonly consisting of a rack or series of notches cast slightly below the machined level of the base, a pinch-bar being used to move the table along.

Built-up box tables are used for machines such as cold saws, when no alteration in the height of the saw is possible. Suitable adjustments of the work for height are brought about by removing or adding sections of the table. Such an arrangement is illustrated in Fig. 29, in which four slots will be seen on the horizontal surfaces, short side slots coming in from the edges at right and left, and longitudinal slots running around the flanks. The union of the sections is effected with bolts slipped into open slots having pockets that give sufficient play for the nuts and a wrench.

Sectional Table Designs

On some machine tools the T-slotted surfaces of the tables are divided into sections between which a tool may operate, or one section be fixed and the other arranged to travel. The space between sectional tables may be either fixed or adjustable. A somewhat unusual practice enables either straight or rotary feeding movements to be employed. This specifically relates to heavy milling machines of the vertical-spindle type. A central rotary table is flanked by fixed straight tables flush therewith, as shown in Fig. 28. Work may be dealt with considering the surface as a whole, or selecting the rotary section only. Thus, work requiring ordinary straight cuts can receive attention first, and then any circular cuts, such as for rounded ends on links or rods, may be made by clamping the piece to the rotary table only.

Two alternatives in the mode of construction are followed: In the first, the three tables are built as permanent members of the machine, while in the second they are each made separate and bolted to the main table. The first arrangement is shown in Fig. 28. The three tables are traversed by hand or power feed, and there is a power rotation of the circular table. A trough below the latter catches the overflow or coolant, while the streams from the flanking tables are controlled and diverted by suitable lips.

Supplementary Tables

Supplementary tables are utilized in various ways and for diverse purposes, such as to merely increase the effective clamping area for large parts, or to receive particular contours that cannot be conveniently mounted on a flat table. Attachments to furnish an unusual movement to a plain table necessitate the provision of a supplementary top, typical examples occurring in radius planing, milling, or grinding attachments. Requirements for extensions may be met in a cheaper manner than by providing an expensive casting of large area, this being evident from Fig. 31 in which simple bars clamped on a boring machine table are extended to support V-blocks into which a connecting-rod is bolted.

Supplementary support in the longitudinal direction of a boring machine table is easily obtained by supplying standard castings of the design shown at A, Fig. 30, to fit on the bed ways. Open-side planers do not usually possess exceptionally wide tables. The reason lies in the fact that much of the work performed on them consists of planing feet or ends, and all the extra support necessary is something to take the sag of the overhanging ends, so that a simple form of supplementary table usually satisfies the requirements. This may be a stout plate mounted on rollers moving along a runway standing

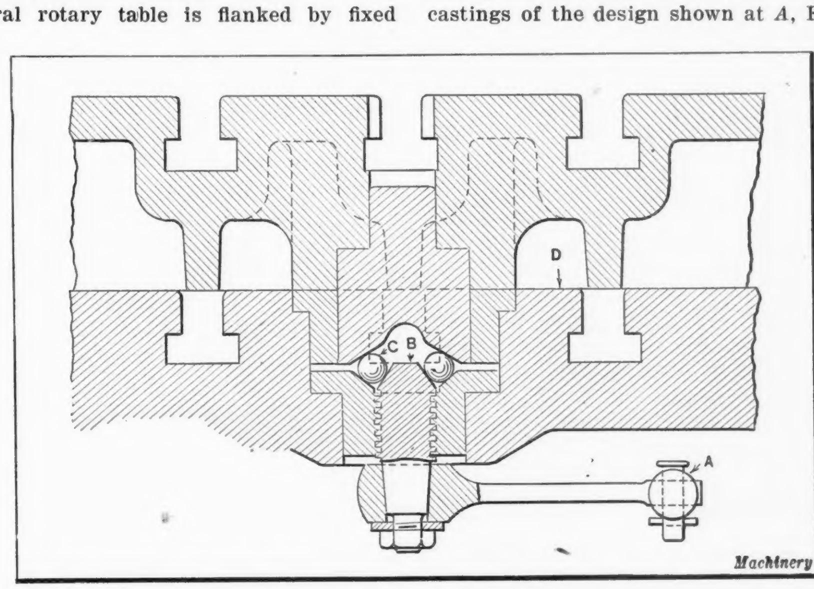


Fig. 35. Device incorporated in the Design of the Turntable to facilitate swinging the Table when heavily loaded

up from the floor, or a box-shaped narrow table sliding in vees as indicated at *B*.

Boring Machine Turntables

An interesting attachment for the tables of boring machines is the quartering table or turntable shown diagrammatically in Fig. 32. This is quite different from the standard rotary table which necessitates a pivot, a flat bearing circle, gib strips, and a worm and worm-wheel revolving mechanism. The turntable requires merely a pivot pin on the main table. It rests directly on the latter, and is indexed by means of a simple tapered peg. This gives four angular settings and intermediate swivel positions for the table. In drilling, boring, or facing at other than right angles, the proper setting is obtained by reference to positions lined out on the work or by means of a templet or bevel strips. Fig. 32 shows square and angular settings with the necessary change in the location of the clamps that bear down on the ledge of the table. Enlarged views of the quartering stop and the clamps are shown in Figs. 33 and 34, respectively.

As the weight of such a table is considerable, especially when loaded with massive work or a cradle or other fixture, some substitute has to be found for the worm-gearing available for turning standard rotary tables. An ingenious device that lifts the whole weight slightly on a central ball race is adopted, whereby a load of tons can be swung around by a pull of the hand. This device is illustrated in Fig. 35. On pulling knob *A*, which extends to the front of the main table, the multiple-threaded screw *B* rises and forces the circle of balls *C* upward, just enough to remove the weight of the table from surface *D*.

A novel combined locating and clamping device for the turntables on a horizontal boring machine of British manufacture is shown in Fig. 36. This device consists of two pinions and two H-shaped pieces having rack teeth at the bottom. The pinions occupy side holes below the main table T-slots. The act of turning a pinion causes it to force the corresponding H-shaped piece along, which, due to its wedge-shaped shoulders, tends to pull the turntable down. This device consumes less time in clamping than the placing of the usual clamps and the index peg in position, and leaves the table surface entirely free from obstructions.

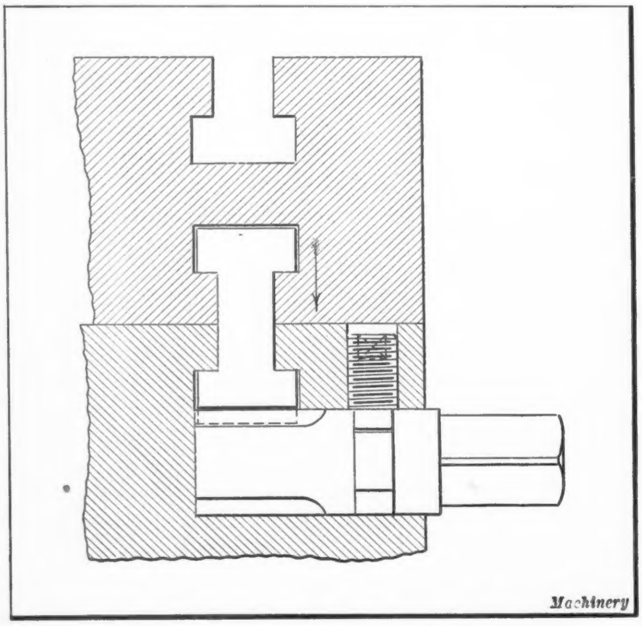


Fig. 36. Arrangement employed on a Turntable for locating and clamping

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The Bureau of Standards has published the results of recent tests made with several new solders for aluminum in Circular No. 78 entitled "Solders for Aluminum."

STABILIZER FOR PRONY BRAKE

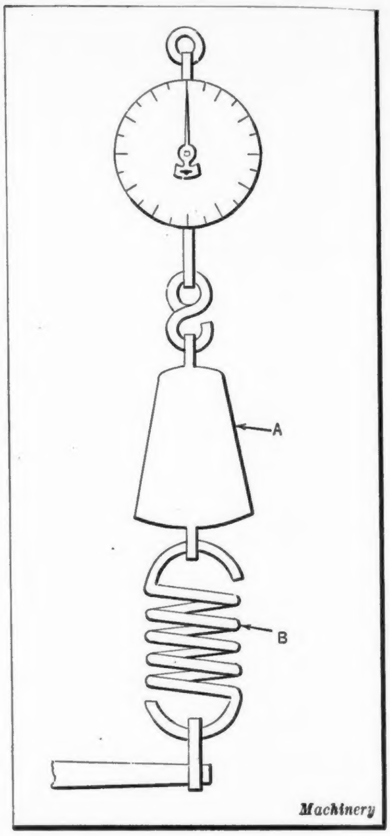
By J. W. ROCKEFELLER, Jr.
Manager Spring Department, John Chatillon & Sons, New York

The most convenient form of Prony brake is undoubtedly that from which a direct reading is obtained by measuring the torque with a spring balance or dynamometer. In using such an apparatus, however, it is often difficult to read the correct position of the indicator, due to the varying friction between the brake and the flywheel, and the consequent vibration imparted to the brake arm. This vibration is present to an annoying degree even when an oil dashpot is used to dampen the oscillations.

The writer has employed a simple remedy for this difficulty in a number of cases, with marked success. The matter of eliminating vibration resolves itself into a problem of mass, force, and acceleration. From the formula,

Force = Mass × acceleration

it will be seen that, with a given force, the acceleration becomes smaller as the mass increases. If the mass is great and the force is exerted for a short period of time only, the velocity attained will be negligible and the motion indiscernible.



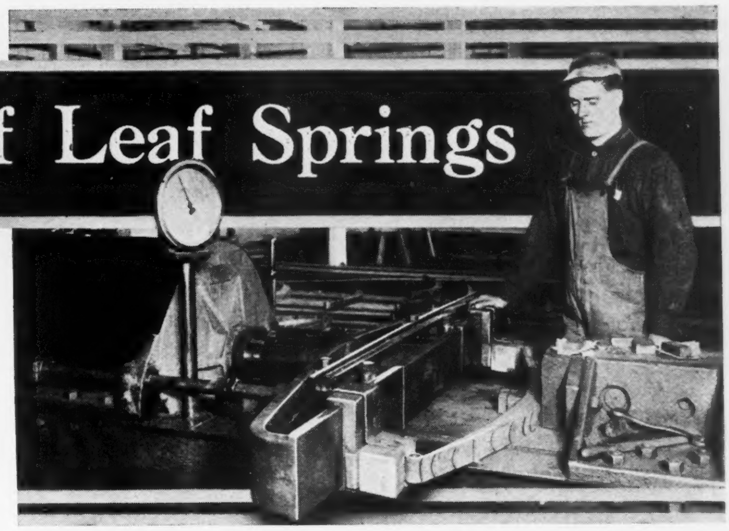
Method of employing Weight to stabilize Prony Brake

This fact is taken advantage of in the Prony brake stabilizer shown in the accompanying illustration. Between the balance and the brake arm are placed in series a heavy weight *A*, and a resilient coil spring *B*. The pointer of the balance is then set back to offset the initial force, or tare, exerted by the weight. When the motor being tested is in motion, the average torque is transmitted through the spring and suspended weight, and is accurately indicated on the dial of the balance. The momentary vibrations, however, are not of sufficient duration to move the weight, and their motion is dissipated by the auxiliary spring. By employing this type of stabilizer, an oil dashpot may be dispensed with entirely, and readings of a high degree of accuracy may be obtained.

* * *

In a paper read before the Birmingham Metallurgical Society, Birmingham, England, it was stated that the general properties of stainless steel, and also its resistance to corrosion, are influenced to a considerable extent by the heat-treatment which the steel has undergone. The material has the greatest resistance when hardened and the least when annealed, and cold working decreases the non-corrodibility to a considerable extent. Among the purposes for which stainless steel has been successfully used in the industries may be mentioned pump pistons, and hydraulic and steam valves of different types. The steel has been found to resist, to a remarkable degree, the erosion of high-pressure steam jets.

Manufacture of Leaf Springs



Methods used in Making Automobile Springs at the Plant of the Perfection Spring Company, in Cleveland, Ohio

By EDWARD K. HAMMOND

THE methods here described are those employed by one of the oldest and largest automotive spring manufacturers in the country. When this company started in business some seventeen years ago, springs were made by what was known as the hand-fitting process. The plates were first heated in the furnace, and then bent to the desired arch over a templet, as shown in Fig. 1. While held on the templet by means of tongs, this arch was maintained by quenching with water. The plates were then placed in the furnace again, heated to the desired temperature, and quenched in oil. The last operation in the heat-treatment required that they be heated again to a lower temperature than previously used, and then withdrawn and left to remain in the air until cool. This method was discontinued when springs had to be made in large quantities, as it was not only expensive but also quite slow. The Perfection Spring Co. was one of the pioneers in the development of machines for doing this work. Present-day methods of spring manufacture will be described in this article.

Shearing the Spring Plates

The raw bar steel is brought into the steel warehouse on freight cars, which are run from the railroad siding on a transfer table that carries them into line with tracks running longitudinally through the building. The proportions of the building are such that the bars can be unloaded from the cars and laid with their ends in proximity to a center aisle. Running down the center aisles are tracks that accommodate trucks on which motor-driven alligator shears are operated. With this arrangement the shears can be brought into a convenient position relative to the particular steel that it is required to use. Fig. 4 shows one of these shears in operation. The stop shown in the illustration can be regulated in relation to the jaws of the shears, so that any length of plate may be cut. All the plates are sheared in this way.

A well-equipped laboratory is maintained, and samples are taken from every shipment of steel that is received, and checked for chemical analysis. If this analysis shows that the steel is not within certain prescribed limits, it is rejected. A certain number of samples are also heat-treated and subjected to physical tests, such as cold-bend tests and tests for determining the elastic limit and tensile strength. The correct temperatures of the heat-treating furnaces are all determined and controlled by the laboratory, so that this all-important item is in the hands of experts.

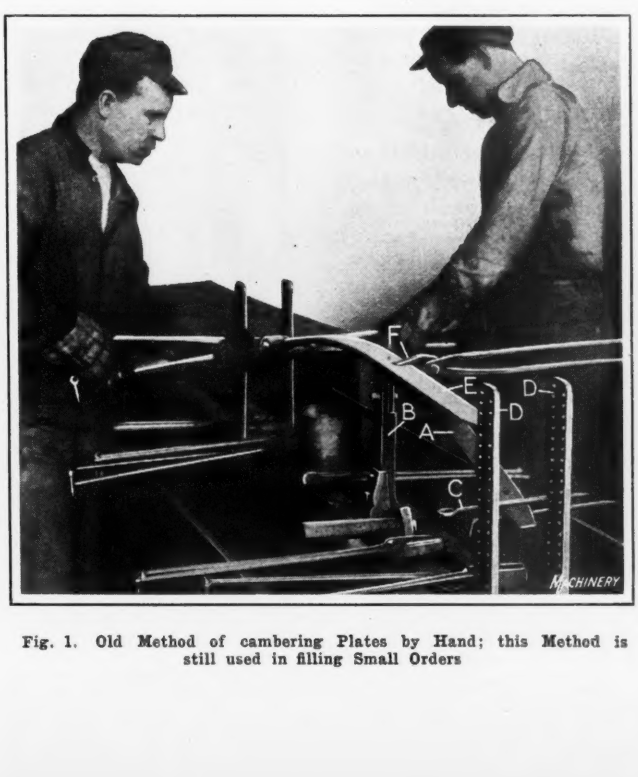


Fig. 1. Old Method of cambering Plates by Hand; this Method is still used in filling Small Orders

Forming Eyes on the Main Plates

The majority of springs are made with eyes on the main plates, this work being done on a special cam-operated eye-forging machine built by the Coulter & McKenzie Machine Co., of Bridgeport, Conn. The ends of the main plate are heated to a forging temperature, and each eye is completed in three operations. First, the heated plate is inserted in a pair of dies, the end is scarfed off, and the eye slightly bent. It is then transferred to a second set of dies, which bends the end of the plate around and closes the eye. In the third operation the turned eye is placed in a set of dies which holds it while a mandrel is forced through to produce the correct inside diameter. One operator performs all these operations on one machine, without changing his position.

After the eye-forging operation has been completed, an entire set of plates for the spring to be made is sent to a lay-out department, where an experienced mechanic marks the positions of the holes to be punched. This set of plates serves as a sample for setting up the power presses to punch the entire lot of plates. Not only are holes punched in the center of the spring to accommodate the center bolt that holds the finished spring together, but clip rivet holes are also punched. Fig. 2 shows the type of machine used.

Trimming Ends of Plates

The next step, after the center and clip rivet holes have been punched, is trimming the ends of the plates. This operation is performed on a motor-driven crank power press illustrated in Fig. 3, and consists of tapering the ends of the plates and producing what is known as a "diamond trim." It

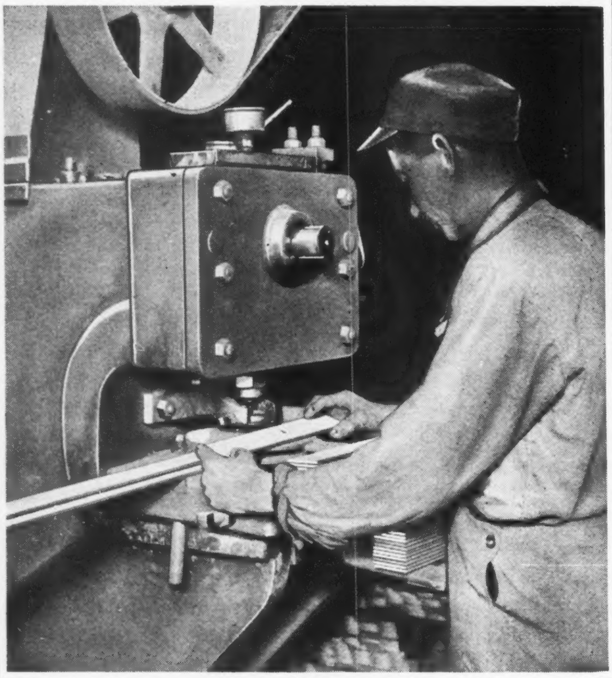


Fig. 2. Punching Center Bolt and Clip Rivet Holes

will be noted that this machine is equipped with four sets of dies for various widths of steel, but other equipment is also used in which a single die only is provided.

Cambering the Plates

Forming the necessary camber or arch constitutes the next operation in the fabrication of the spring. The plates, in complete sets to make up a spring, first go through an oil-burning furnace equipped with a walking-beam type conveyor. After passing through the furnace, the plates are removed at the opposite end, having been heated to a temperature of 1500 to 1600 degrees F., depending on the grade of steel used.

On the cambering machine there are two forms which are flexible and adjustable by means of set-screws. When a plate comes out of the heating furnace, it is placed on the lower form, after which the motor is started, which operates a screw ram causing the upper form to descend. This squeezes the plate between the two forms and bends it. Actually, a plate, called a "pattern plate," is placed between the lower form and the spring plate to be cambered, but this has no mechanical function, being used merely to prevent the continued application of hot steel on the lower form, which would rapidly destroy it.

After the bending, both the forms descend against the tension of coil springs, so that the heated plate being cambered is submerged in a bath of oil. Thus the plate is formed to the desired shape and quenched in oil in one operation. There is a slight tendency for the plate to spring back after it is removed from the dies in the cambering machine, and consequently the forms are set to a curvature somewhat in excess of that required, in order to provide the necessary compensation.

Several different forms of power-driven cambering machines are used, according to the class of work being handled, and while the principle of operation is the same, certain variations are required for different types of springs. When there is a reverse curve on the springs, it is necessary to employ both an upper and a lower form, so that the reversal of curvature can be accomplished by means of the set-screws that control the shape of these forms. In the case of springs having a curvature in one direction only, a lower form is used, and the upper member consists simply of a flexible band which is pulled down on the heated plate, causing it to take the required form.

Tempering the Spring Plates

At this point the steel is exceedingly fine in structure, but it has an undesirable degree of hardness. To remedy this, plates are placed in a furnace of similar design to the ones in which the plates are heated preparatory to cambering. The walking-beam conveyor is so timed that it takes about one hour to carry the steel the length of the furnace. The temperature of this drawing furnace is considerably lower than that of the heating furnace, being about 860 degrees F. After being removed from the furnace, the plates are allowed to cool in the air.

As a means of checking the heat-treatment, a certain number of plates are turned over to an operator, working under the direction of the laboratory, who tests them by means of the Brinell hardness machine. Certain prescribed limits have been set for this hardness, and all tests must show that the plates are well within the limits before they are permitted to proceed further.

Block-fitting

The next process after tempering is known as "block-fitting." At the discharge end of each tempering furnace there is a work station, where fitting blocks and a set of master plates of the correct form for each of the spring plates are used in block-fitting the springs. The block-fitter takes the various spring plates as they come through the furnace, and places them on a flat plate beside the corresponding master, in order to test their form. Each plate in the spring must fit the plate next to it. During the process of block-fitting the steel is hot—that is to say, it is about the same temperature as when it leaves the tempering furnace.

Grinding the Faces of the Spring Plates

As a leaf spring is deflected, the action causes the plates to slide on each other. In order to facilitate this action, it is necessary to surface the contact faces of the plates. This consists of removing the loose scale formed when the plates are tempered, and the rough spots on the surface of the steel. The surfacing is done on a grinding stand, and is by no means a finish-grinding operation. It is merely required to remove those spots that are sufficiently rough to seriously impede the sliding action. The amount of grinding that is done on the plates varies in accordance with the customer's specifications.

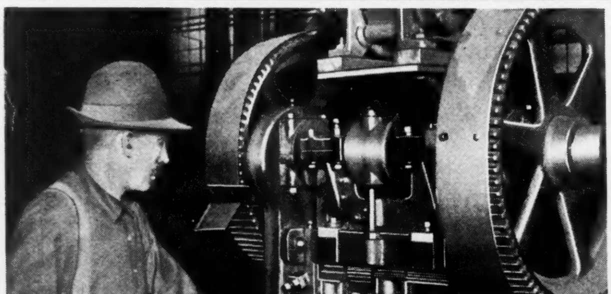


Fig. 3. Press used in trimming Ends of Plates

Pressing in Bushings and Milling Eyes

After the scale has been thoroughly removed from the plates, the springs are placed on a conveyor table for assembly. The first operation consists of pressing bushings into the eyes of each main plate. This is done by an air-operated arbor press. After the bushings have been pressed in, the plate is transported to a Gardner duplex ring-wheel grinder, on which the faces of the eyes are ground. This machine is equipped with a sort of cradle on the rocker arm, in which the under side of the eye is supported. The end of the plate is passed between the two opposed grinding wheels, so that the faces of the eyes are ground to a uniform surface, and the bushing to exactly the required width. After the eye has been milled, the inside diameter of the bronze bushing is reamed to the desired size.

Final Assembly and Inspection

When the foregoing operations have been completed, the main plate is again placed on the conveyor table, together with the rest of the plates of the spring, and the operator applies a graphite grease lubricant with a brush to each of the ground surfaces. As the plates are carried along, the rebound and alignment clips are riveted in place. The plates are then assembled on a pin through the center-bolt hole, after which the pin is removed and the center-bolt inserted and tightened. Clips bolts and spacers are then assembled, the nuts tightened, and the ends of the bolts cut off and riveted over, so they will not become loose.

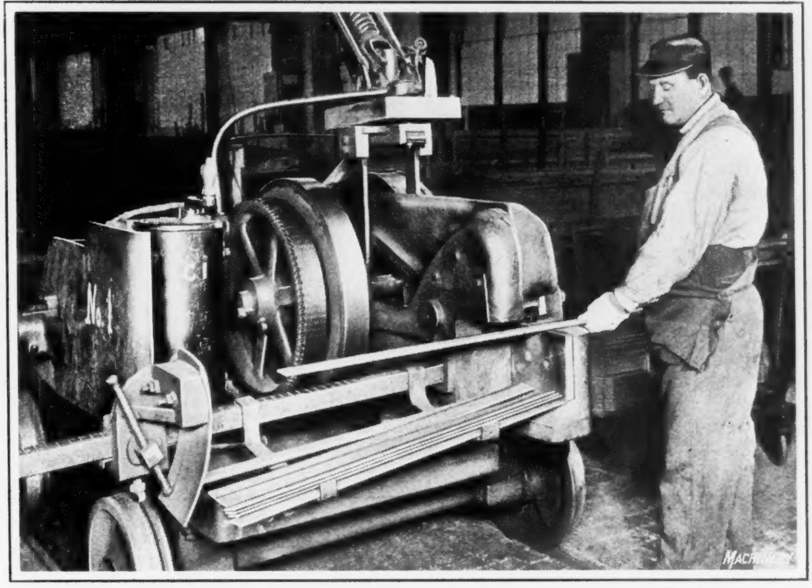


Fig. 4. Cutting out Plates to the Proper Lengths on Alligator Shears

The springs are next subjected to what is known as a break-down test, which consists of first measuring the opening of the spring, then deflecting it to very near the elastic limit of the steel, releasing it, and again measuring the opening. This is really a further test for heat-treatment. If it is correct, the spring will return to its original position.

The inspector then goes over each spring thoroughly, checking up the reaming of the bushings, milling and parallelism of eyes, etc. It is essential that the eyes be parallel with the body of the spring and also with each other, in order to facilitate assembly of the spring on the car. The test for parallelism is made by placing the spring in an upright position on a surface plate. Rods are then placed in the eyes and the necessary measurements taken. These measurements have to be within certain limits.

The final operation on the completed spring consists of a capacity test. This is carried out on an Olsen testing machine, the rate of deflection of the spring being checked, as is also the height of the spring under the normal load that it will carry under the car. The heading illustration shows the machine employed for this purpose. After being tested, the springs are ready for shipment.

* * *

According to *Safety Engineering*, statistics show that industrial accidents increase considerably on cloudy days, when artificial lighting is used for a considerable part of the day. This points to the need of proper artificial light.

COOPERATION OF ENGINEER AND DESIGNER

By THOMAS A. REILLY

Both the engineer and the designer have important work to perform in developing or bringing out a new machine. Hence a spirit of cooperation should exist between these two men; otherwise each will be greatly handicapped in his work, and the product of their labors will suffer as a result. Each man should concentrate his efforts on his own part of the job, and not attempt to encroach on the other's work or criticize it simply because *he* would do it in a little different way. As a general rule, it is the designer's place to work out constructional details, and the engineer's place to check the principles involved and see that the design as a whole will meet requirements.

Unfortunately, some engineers acquire the habit of making trivial changes in the details worked out by the designer. Unnecessary changes of this kind only serve to create a feeling of resentment in the mind of the designer, whose experience in such matters may be of more practical value than that of the engineer. The engineer who acquires this habit is likely to allow himself to be led off into a maze of insignificant details, while the principles underlying the work, which it is really his job to check up and verify, are lost sight of. As a result, ideas incorporated in the work by the designer which should receive the careful consideration of the engineer are often allowed to pass his inspection unnoticed.

In order to form an efficient productive unit or "team," the engineer and designer must have confidence in each other's ability. Mutual confidence requires that each man perform his own particular work carefully and intelligently. Once this condition is established, a spirit of cooperation will invariably develop, which will be far-reaching in its benefit to both the men and the company that they serve.

* * *

THE SWEDISH MACHINERY INDUSTRY

The situation in the Swedish machinery industry, as indicated by official statistics, shows a slight improvement for the better. There were 311 shops in operation last fall, many of which had been closed for a considerable time. No material change has taken place, however, in the number of workers employed, nor in the number of working hours. Wages in the industry are about 40 per cent below the scale prevailing in the latter part of 1920. The best employment is in mining machinery, electrical machinery, paper mill equipment, and shipbuilding. The shops engaged in agricultural, road-making, match-making, metal-working, and woodworking machinery have only a few orders on hand. German competition is still felt quite definitely in the Swedish market, and foreign competition, in general, shows no signs of becoming less serious, which is partly due to the fact that the exchange value of Swedish currency has reached its normal basis. The stocks of machine tools on hand are quite large.

Burnishing Machine for Crankshaft Bearings

By JOHN E. COLLINS

A MACHINE that eliminates the old hand method of scraping in crankshaft bearings of automobile engines is described in the following: The whole engine, so far as the main bearings are concerned, is limbered up in one operation on this machine. The bearings, as they come to the burnishing machine, are reamed a little under size. The cylinder block, with the crankshaft, camshaft, and pistons assembled, is placed in the special fixture of the burnishing machine, and the crankshaft is then turned over at the rate of about 610 revolutions per minute for a period of about one-half minute. During this operation the crankshaft is left dry. A mixture of oil and compound is then pumped directly to the crankshaft bearings, and the rotation continued for about five minutes.

The cylinder block is next transferred to the assembly track where the final assembly operation is completed. At the end of the assembly track the crankcase is filled with oil, and the complete engine goes to the dynamometer test block where it is given a running test for two or more hours under various loads. This burnishing machine should not be confused with a running-in machine, which simply takes the stiffness out and gives the bearings a smooth finish. The machine described in this article is used in the plant of the H. J. Walker Motor Co., at Cleveland, Ohio.

The bearings are reamed about 0.004 inch under size when they come to the burnishing machine. This excess metal grips the shaft tightly and must be rolled down to permit the shaft to turn freely. The rolling down operation must be completed quickly (in one-half minute, as mentioned previously) in order to prevent the bearing trom heating up and "freezing" to the shaft or the babbitt bearings from being melted. In order to accomplish this, a thirty-horsepower, three-phase, sixty-cycle, 440-volt motor is used to drive the burnishing machine. This motor is connected through a silent chain drive to a large shaft which turns a heavy cast-iron flywheel. The flywheel is 22 inches in diameter by 18 inches thick, and is bolted to one member of a 30-inch cone clutch which can be quickly engaged or disengaged by a conveniently located handle. Thus the motor and flywheel may be allowed to turn without driving the remaining parts of the burnishing machine, when desired.

When the clutch is engaged, the turning pressure is transmitted through an Oldham coupling to the crankshaft of the cylinder block placed in the burnishing fixture. The part of the Oldham coupling to which the crankshaft is attached is shown at *A* in the illustration Fig. 1, which is a side elevation of the cylinder-block holding fixture. The principal parts shown in Fig. 1 are easily identified

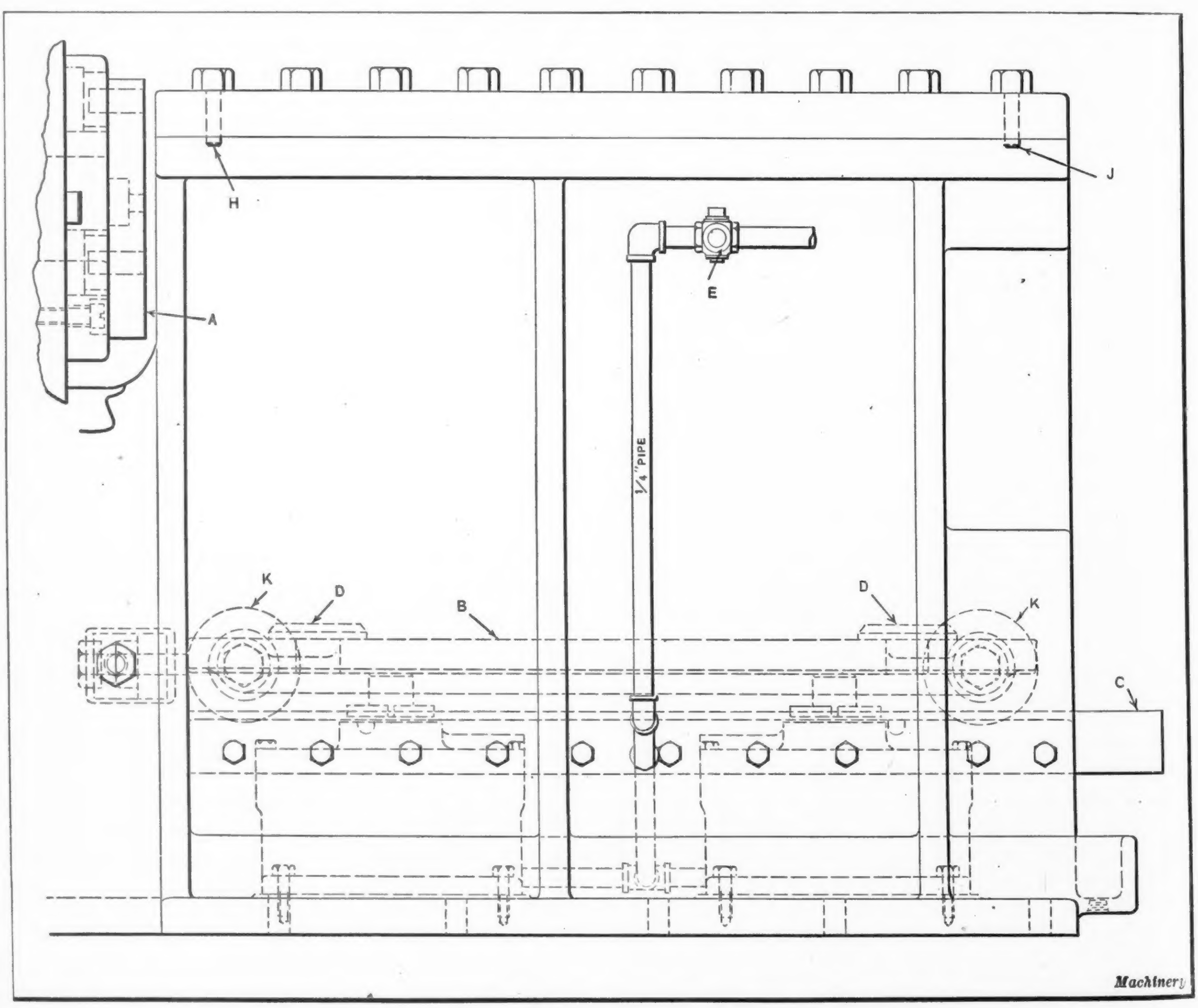


Fig. 1. Cylinder Block Holding Fixture of Crankshaft Bearing Burnishing Machine

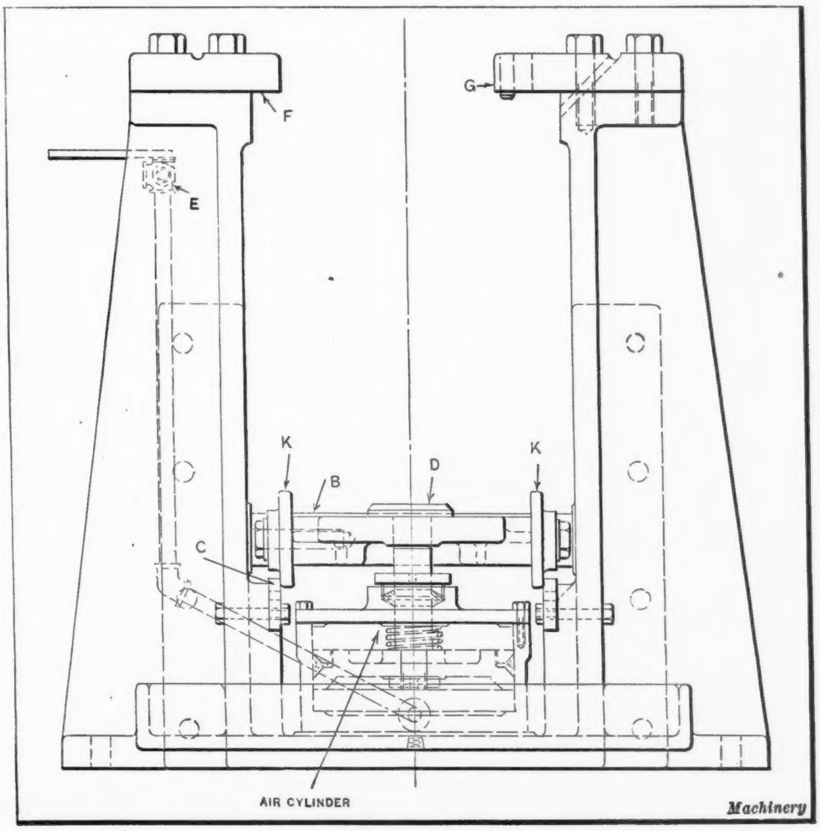


Fig. 2. End Elevation of Fixture shown in Fig. 1

in the end elevation, Fig. 2, as the same reference letters are used in both illustrations.

The carriage *B* is rolled out from the fixture on the track *C* so that the cylinder block can be lowered on it. The cylinder block is brought to the burnishing machine without the head assembled, and is put in the carriage with its bottom flange up so that the crankshaft can be readily inspected and the bearings adjusted, if necessary. Two round blocks or pins *D* serve to position the cylinder block on the carriage when it is rolled back into the fixture. The air valve *E* is then opened. The carriage has two air cylinders under it which lift the carriage and the cylinder block against parts *F* and *G*, where it is located by two pins *H* and *J*, Fig. 1, which pass through holes in the cylinder block flange. The carriage is shown in the raised position but with no cylinder block in place. As will be noted, the flanges on wheels *K* do not leave the track *C*. The flange at the end of the crankshaft is bolted directly to the flange of the Oldham coupling *A*.

* * *

A COURSE IN MACHINE SHOP PRACTICE

A comprehensive course in machine shop practice has been introduced at the University of Michigan, and has recently been described by O. W. Boston, acting director of the engineering shops and assistant professor of shop practice. The new course is a substitute for the ordinary manual training course generally provided, and gives the student a broader viewpoint of present-day machine shop practice, at the same time emphasizing the economic features of quantity production work.

The present course includes both lectures and actual shop production work. It gives definite information on the history and development of quantity production and present practice, together with questions and problems. Lantern slides are used in connection with the lectures to illustrate the development of typical machines and tooling set-ups. In the shop, 30 per cent of the time is devoted to tool-room work, involving the use of machines not commonly employed in production; and 70 per cent of the time is devoted to the manufacture, in quantity, of two small devices. This serves as a training for the student in production methods and illustrates the economic factors that tend to reduce costs by quantity production and standardization. Jigs, fixtures, and gages are freely used, because it would be impracticable to demonstrate successfully the use of production machinery, such as automatic screw machines and turret lathes, without the use of special tools and gages. The value of jigs, fixtures, and gages can be definitely shown to the student only by having him engage in actual quantity production. The simple routine of labor also is emphasized, so that the students may recognize that this routine is one of the necessary elements in production. As all operations are worked on simultaneously, the "flow of material" from operation to operation is illustrated.

In order to produce a large variety of parts at low cost when each part requires several operations, routing cards, stock records, time studies and instruction sheets are necessary. The course at the university includes all these features, and the students become acquainted with actual factory procedure in this way. The material for the devices built is furnished by an outside commercial concern, which also sells the finished product. This relieves the educational institution of any commercial activities; but an agreement has been made between the university and the manufacturer, whereby the university receives a certain amount for the labor required to produce each device. This compensation is slightly below what would be a commercial price, and in return for this concession, the university is free from any obligation to meet delivery schedules and is given a higher scrap allowance on material than would be permissible in regular commercial work.

Apart from the production work, the course includes thorough instruction in the history of production engineering; the elements of accounting in quantity production; stock records; application of standardization as affecting machines, tools, and materials; time studies; wage payment plans; different types of machine tools, and the cutting tools used in them; materials for cutting tools; speeds, feeds and cutting lubricants; milling cutters, drills, reamers, taps, dies, broaches, grinding wheels, and methods used for grinding, buffing and lapping; gears, gear-cutting, and gear-cutting machines; jigs, fixtures, and special tools; standardization, measuring instruments, and gages; automatic machines; die-casting; punch and die work; metal spinning; and a specific example of a manufacturing lay-out for producing a given article in quantity.

In the instruction relating to the subject last mentioned, the entire process, beginning with the drawings, is entered into. Experiments necessary to determine the best design of the product are dealt with; and the question of whether to purchase or manufacture parts is taken up, together with the ordering and fixing of delivery dates for all materials; the determining of material required for different parts—castings, forgings, stampings, and bar stock; machining methods to use; the selection of machine tools; routing and instruction sheets; the design of jigs, fixtures, and gages; and time study of the operations and inspection methods. A course of this kind will tend to prepare the college-educated engineer for quantity production work in the industries, and will tend to make college-trained engineers less scarce in production shops.

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FREE ENGINEERING SERVICE

A recent editorial in MACHINERY calling attention to the heavy burden placed on manufacturers of machine tools in supplying prospective customers with free engineering advice, has brought out additional information in regard to this practice. One of our leading machine tool builders recently stated that an important factor in the increased cost of machine tools is the free engineering service furnished in connection with the sale of machines. Neither the increased price of materials nor the higher wages add so much to the cost as does the consulting engineering advice required by some customers. Frequently the cost of this service is so great that it not only eliminates any profit from the transaction, but actually produces a loss.

One case was mentioned which, though extreme, illustrates the point very clearly. A buyer who was in the market for a machine costing about $1800 requested each one of the prospective sellers to send, not only a salesman, but an engineer, to look over his factory and advise him in regard to the best method of producing his work and the tooling equipment required. After the visit of inspection all the bidders furnished tooling lay-outs and designed special equipment to aid the customer and to induce him to buy their machine. When, finally, the order was placed for the $1800 machine it was found that the competing manufacturers had spent in traveling expenses, engineering and drafting-room work about $2400. In another case, a prospective buyer of a machine tool selling for $2800 asked the manufacturer to furnish data which would have cost approximately $1000 to compile, and which the latter of course declined to do.

One manufacturer developed a design for a machine that could be sold for $750 when built in lots of fifty to a hundred. This cost estimate did not include any provision for free engineering service, and when the machine was placed on the market it was found necessary to raise the price to $1000 to cover the overhead charges caused by free engineering advice, providing tooling lay-outs, making time estimates and sending demonstrators to some of the customers' factories to train their men in the operation of the machine.

It is true that many customers ask for no engineering service, but those who do ask for it thereby increase the cost of the tools requiring it, and get something for which the buyer who needs no service helps to pay. Several machine tool manufacturers say that the large concerns are the ones most likely to insist on this free service, although they are better able to pay for it as a separate item; but under existing competitive conditions it is difficult for a few manufacturers to insist upon such a payment. It is also difficult to draw the line between legitimate service and that which is really an imposition upon the manufacturer.

* * *

DESIGNING ENGINEERS NEEDED

This month thousands of young men will graduate from our engineering schools and colleges to enter various industries. Their training was intended to qualify them to become designers of machinery, but a comparatively small number of the graduates of engineering schools devote themselves to machine design; the larger number, as shown by a questionnaire recently sent to the alumni, seek to enter the sales department or to obtain office positions.

A mechanical executive of one of the largest builders of steam, electric and hydraulic equipment in the country recently stated that unless engineering design could be made more remunerative to young engineering graduates there would be a distinct scarcity of that type of engineer in ten or twenty years. The compensation and opportunities offered to engineers who undertake selling and industrial efficiency work are generally so much greater than those offered to the designer that many who may be qualified for either line of work will select the former. This will bring about a serious condition in the engineering industries; because, manifestly, without a sufficient number of able designers, particularly in the electrical and power generating fields, we shall find ourselves in the position of following instead of leading European nations in new mechanical developments.

At present many designing engineering positions in important plants are filled by men born and trained abroad; and while all are welcome, manifestly it is desirable that the training facilities of American engineering schools should be used to their fullest capacity in training native born engineers. No engineering schools in the world are so well equipped as ours, and a large proportion of their instruction is wasted if the specialized engineering knowledge their graduates acquire is not used to a greater extent in the particular field where it is most needed.

This condition merits the consideration of all executives in the machine-building industries. As we shall need skilled labor in the future and must provide for the proper training of young men in shop work, we must also provide for the training of a sufficient supply of designing engineers, or the work for the shop men will be lacking. Our theoretical training is well taken care of, but when the young men finish that, they should find the designing engineer's work sufficiently remunerative to warrant taking it up, if their inclination points that way.

* * *

KEEPING NEW EQUIPMENT IN REPAIR

One of the important factors in improving business in the machine-building field has been the active railroad buying during the past year. During the fifteen months ended March 31, our railroads authorized expenditures amounting to $1,540,000,000 for new locomotives, cars, tracks and other facilities. In that period over 4200 new locomotives were ordered, of which about one-half were placed in service; nearly 225,000 new freight cars were ordered, of which about 118,000 were put in service.

To keep this new equipment in good condition, additional shop facilities and machine tools are urgently needed. During the past year the railroads have ordered considerable new equipment for their shops, and some machine tool builders have found the business from railroad shops and locomotive building plants a very important part of their total sales. The mechanical executives of the railroads know that the full benefit of new locomotive equipment and other rolling stock can be obtained only by the operation of good shop equipment, and the increased railroad buying indicates that the men responsible for the finances are also beginning to recognize this. The effect of this new attitude is already in evidence. On May 1 the railroads had fewer locomotives in need of repairs than at any time since the American Railroad Association began to keep records. On that date the number of serviceable locomotives was 50,259, and those in need of repairs requiring twenty-four hours or more, 12,473. Better machine tool equipment will reduce this number still further.

The Upward Trend of Business

By A. W. HENN, President, The National Acme Co., Cleveland, Ohio

THERE is every reason to believe that the present activity in nearly all lines of business, which amounts to a boom in some industries, will continue throughout the year. Every factor making for business prosperity and stability is favorable, and nothing short of a catastrophe can be expected to change the course of business during the present year. There is no serious labor unrest; and no labor troubles of any importance are in sight except in the building trades, where periodically—every spring—there are local strikes at the very time when it would be to the greatest benefit of all concerned to preserve peace. The important fact to consider, however, is that there is now industrial peace in the great fields of employment—steel mills, textile industries, coal mines, and railroads.

While labor is not inclined to create industrial disturbances by means of strikes, there is a tendency for wages to rise still further from what is already a high level, so that we are seemingly close to the border line of labor inflation, if not now at or even partly across it. With labor and materials tending upward in the metal-working industries—notably in the machine-building industry—prices in general will rise for the next six months at least. Labor again shows a tendency to shift from job to job, and manufacturers must recognize the fact that hiring men away from other employers does not increase the labor supply. This practice merely increases the cost of manufacture, causing prices to rise and producing stagnation of business, because buyers are unwilling or unable to pay the mounting prices.

An undue increase in the cost of materials will tend to bring about the same conditions. Already certain steel that a year ago sold for 1.60 cents a pound sells at 3 cents; and pig iron, which was sold at $20 a ton, now sells at over $30. If prices for raw materials in the machine-building field go much higher than this the tendency will be to curtail buying and slacken the pace of manufacture. There is every reason to believe, however, that material prices are not going to rise much higher, because, on the one hand, those in control of raw material prices do not want a repetition of the 1920 experience, and on the other hand, manufacturers are buying more conservatively, so the present demand will not increase much. If manufacturers generally will be conservative in their buying and will refrain from indiscriminate hiring of men away from others engaged in the same line of business, the present period of prosperity is likely to last much longer than it otherwise would.

The Railroad Situation

One of the most favorable signs pointing toward a continuation of business prosperity and normal conditions in industry is found in the railroad situation. The railroads are beginning to get back into their own. They are in a better state financially at present than they have been for many years past. The public attitude toward the railroads is also more favorable. There is less likelihood of injurious legislation and better prospects for constructive aid. The railroads will have some difficulty in handling the traffic that will be offered to them during the remainder of this year, but they are striving energetically to meet the situation. A larger number of locomotives and cars will be built this year than at any corresponding time in the history of American railroads; and as the industries have become adjusted to the increased freight rates and fares, it is not likely that any serious pressure will be brought to bear to impair the financial position of the roads.

The Automobile Situation

Fears have been expressed that during the latter part of this year there will be a serious curtailment in the production of automobiles. While it is likely that the production cannot continue throughout the year at the present pace, which would mean a total production for the year of over 3,000,000 cars, it is not generally believed that there will be anything like the slump that was experienced in 1920. The country as a whole is prosperous, and there are still a large number of new users of cars coming into the market. Furthermore, as has been pointed out by Colonel Ayres, in his careful investigation of the subject, the life of an automobile may at present be estimated at seven years, and as there are over 12,000,000 cars in use, the demand for replacements alone would be close to 2,000,000 cars annually. While there doubtless will be fluctuations in the automobile industry, the same as in every other line, the automobile is now so firmly established as a means of communication that the production must go on at a reasonably constant pace. This production is not likely to be less than 2,000,000 cars a year, and probably will average beweeen 2,000,000 and 3,000,000 cars for many years to come.

Machine Tool Prices

A subject that is of particular interest to the makers and users of machine tools is that of machine tool prices. Some buyers intimate that if machine tools increase a great deal more in price, there will be a curtailment in buying. The answer to this is that machine tools, as well as other products, cannot be priced solely with a view to encouraging buyers; the price must be equal to the cost of production, plus a reasonable margin of profit. Surely the manufacturer whose enterprise and ingenuity has made possible the development of the modern types of machine tools is entitled to something more than the mere cost of production. In any event, present machine tool prices, when compared with the prices of other classes of machinery of equal quality and ingenuity of design, are unusually low. Machine tools sell anywhere from 20 to 50 cents a pound; whereas many other lines of machinery sell at prices up to $1 a pound.

In the machine tool industry, it may be conservatively stated that, on an average, only three years out of every four, produce a return to the manufacturer, and the fourth year almost invariably entails a loss, due to the periodic decrease in demand for machine tools. In an industry subject to such fluctuations, it is therefore necessary—and all machine tool builders, if they expect to remain in business must consider this fact—to earn such an amount during the three years when the demand is about normal that the business may be carried without undue loss during the fourth.

Buyers of machine tools cannot be expected to consider this fact, as they naturally are interested merely in obtaining their equipment at the cheapest price possible at the moment, but manufacturers of machine tools must carefully plan ahead, so that both their individual plants and the industry as a whole may be placed on a firm financial basis. It is only by so doing that they will be able to employ a sufficient percentage of their earnings in experimental and development work, a prime necessity if they are to keep pace with the constant demand for improved equipment.

National Machine Tool Builders' Convention

THE twentieth spring convention of the National Machine Tool Builders' Association, held at Hotel Greenbrier, White Sulphur Springs, W. Va., May 9 to 11, was characterized by the attention given to administrative and executive problems now facing the industry. In addition to the discussions of association activities at the convention, two unusually interesting and valuable addresses were made, one by Dexter S. Kimball, Dean of the College of Engineering, Cornell University, on "Machine Tools: The Master Tools of Industry," and one by C. A. Plaskett of the U. S. Forest Products Laboratory, Madison, Wis., on "Making Better and Cheaper Containers for Foreign and Domestic Shipments."

Ralph E. Flanders, manager of the Jones & Lamson Machine Co., Springfield, Vt., was elected a member of the board of directors of the association, to succeed Winslow Blanchard, president of the Blanchard Machine Co., Cambridge, Mass., who died April 7.

President Kearney's Address

In his address, E. J. Kearney of the Kearney & Trecker Corporation, Milwaukee, Wis., president of the association, laid particular stress upon two questions: "Have We Learned Anything from the Long Period of Idleness?" and "What Steps can be Taken in Preparation for the Next Depression?" Mr. Kearney said in part: "I shall not attempt to make a catalogue of all the lessons that have been learned or of all the defenses that should be set up, but reference to a few may serve to stimulate thought and provoke discussion, and thereby be the means of bringing out the answers. May not the following be considered as answers to the first question?

"1. The demand for machine tools is subject to the greatest fluctuations, even greater than that for the most useless luxuries.

"2. A continuous record plotted into a curve showing the fluctuations in volume of orders on a percentage basis, using any selected period as 100 per cent, is of the greatest value and would have saved millions in 1920.

"3. The beginning of a period of depression is the wrong time to accumulate stock.

"4. Price reductions have no bearing whatever on the sales of machine tools.

"5. Idleness costs money, but is unavoidable from any knowledge that we now possess.

"6. The absence of substantial cash reserves with which to enter a long period of depression means price cutting, loss of self-respect, discredit among our competitors, humiliating pressure from banks, expensive refinancing, creditors committees, or receiverships.

"As to the second question 'What Steps can be Taken in Preparation for the Next Depression?' the following suggestions may be made:

"1. Closer Cooperation with Dealers. A new concern, without any knowledge of how to reach the user, may copy the design of an existing machine and get it on the market in good times through the medium of a dealer. This is, in a large measure, responsible for the highly competitive conditions and the low prices that usually prevail in our industry. This is especially true of tools that are simple in design, such, for example, as upright drills and shapers, but extends throughout the entire line, though in somewhat less degree. Thus a new competitor is launched with no knowledge of costs or prices. It would not be generous, or in accord with public policy, to set about trying to prevent the development of new competition on the part of capable and experienced men; but there should be more cooperation with the dealer in this regard, for the practice leads not only to a weakening of old established concerns, but to loss, disappointment and bankruptcy to the uninformed who make a start in boom times. The manufacturer who relies on a dealer should see to it that the dealer relies on him. There should be mutual confidence and close cooperation for the good of both. This policy broadly and intelligently followed will help when the next slump comes.

"2. Study of Business Curves. A second way in which preparation can be made for the next depression is to get in the habit of closely following the percentage curve showing in what direction the volume of new business is going, and at the first sign of a distinct downward tendency, to decrease the volume going through the factory before it is too late to prevent the accumulation of a dangerously burdensome inventory, as was done in 1920.

"3. Accumulating a Surplus to Meet the Depression. The third item in the list of things to do in preparation for the next period of idleness is to prepare for its cost. No argument need be advanced, for the reason that our experience is all too recent. The deficit is not yet wiped out. The money that has gone and the debts that have come, both testify to the cost of idleness. When business recovers and orders are coming in in excess of plant capacity, machine tool builders, although they are among the steadiest and most conservative of business men, begin to relax their vigilance. It is not so well understood as it should be that overhead kept down in good times will help to keep down the cost when the orders are few; nor, perhaps, that the burden reserve accumulated in the good years will have a tendency, when rightly viewed, to keep dividends down to a safe and wholesome basis, prevent overexpansion, and generally steady the industry.

"4. If the assumption is correct that price cutting to one customer and selling at top prices to the trusting buyer, is no longer followed by men of intelligence and common business integrity, we can devote ourselves to a consideration of the factors that enter into price. The selling price of machine tools depends on five principal factors: (1) Usefulness to the buyer. (2) Cost. (3) Competition. (4) Reputation. (5) Selling methods. There is an increasing tendency to give first place to competition in establishing the price, when in reality usefulness to the buyer and cost are the main factors."

Relation between Price and Competition

In further discussing the methods for setting a fair price for the product of a manufacturer, Mr. Kearney pointed out that the uses to which a machine may be put are infinite in variety. For that reason a special, and perhaps exclusive feature, is of no particular value except to a certain percentage of the buyers, say, for example, 30 per cent. Fixing the eye on competition and setting the price low enough to obtain 35 per cent of the business, may result in the total elimination of profit from the 30 per cent of the cases for which the machine is best adapted.

There is a place for the light, low-priced machine where it will answer the purpose just as well, or better, than a heavy one of higher price. The heavy machine, in striving to compete, throws away its profit on all sales, including those for which it is best adapted, by attempting to enter a field where it would not be found except as an incident, being used in part on work for which the light machine is

ill suited. The same principle applies to highly developed, as against simple machines, and also to machines of high accuracy and finish as compared with ones in which these features are absent.

It is not possible for one shop to build all classes of machines in a given line, as, for example, heavy and light, highly developed and simple, those of greater and less precision, for the reason that such a mixture could not be manufactured with the same shop personnel, and the concern attempting such a program would have much difficulty in marketing the higher grades. This is no reflection on the makers of the lower grades. They have their field, but the maker of the accurate product should not attempt to reach their price, nor is it necessary.

Competitive Basis of Machine Tool Industry

"The machine tool business is highly competitive," said Mr. Kearney, "but fortunately price is not the only basis for competition. The concern that brings out a new machine, or adds a few features to an old one that will increase production or improve the quality of the product over that of previous standards, is performing a public service for which it should be rewarded.

"There is another subject that has been much in our minds of late and that may have a vital effect on the competition of the future, tending in the direction of price competition rather than in the direction of design and quality—that is, standardization. There is room for progress in the matter of standardization, but it must be pointed out that the nearer together machines of different makes come in their general dimensions, the nearer together they will come in price.

"Let us build the best machines that can be made, build them with points of real difference. Let our product, to some degree, reflect our individuality.

"A stranger listening for the first time to the complaints that we manufacturers make about our industry would probably go away with the idea that there is nothing desirable in the manufacture of machine tools. Such, however, is far from the case. It is not a get-rich-quick route. It is something more worth while. It is the foundation of mechanical progress. We are in it not only for the money that can be made, but for the real joy of it. Go where you will, no industrial center will be found where manufacturing is being carried on, be it cornhuskers, printing presses, automobiles, or airplanes, that does not have among its leaders and men of affairs graduates of the machine tool shops of Hartford, Worcester, and Providence. In this respect, we are performing a really valuable service in training mechanics to go out into all the world as apostles of progress. Is this service to humanity not a service worth striving for?"

Report of Mr. DuBrul

In his report on business conditions and association activities, Ernest F. DuBrul, general manager of the National Machine Tool Builders' Association, stated that since last October there has been a considerable increase in activity in the industry, but it is not likely that this increase will continue at a very rapid rate from now on, because the activity of other industries is limited by the supply of labor, and until a more ample supply of labor is available we are not likely to witness much expansion of manufacturing facilities. The machine tool business necessarily shows its greatest activity when other industries are greatly expanding their facilities.

Statistics on building operations indicate that the end of the building boom is very close at hand. The high cost of buildings at the present time is likely to prevent many projects heretofore contemplated from reaching the point of contracting. Railroad buying has not been so large as it should be in view of the conditions of the railroad shops, which are badly in need of much new equipment. But no matter how much they might like to have new equipment, the railroads do not buy it unless they can see good prospects of paying for it.

Forecasting Business Conditions

It was further stated by Mr. DuBrul that it has been visibly demonstrated, by statistics and charts, that the machine tool business is one of the most irregular of the industries, and is subject to longer and deeper depressions than the average. It is of prime importance, therefore, and should be of great interest to all machine tool builders, to use every means available in forecasting conditions so as to keep their own individual businesses in a healthy state. The better forecasts that all business men of the country learn to make, the less serious will be the swings of the business cycle. It is the duty of industrial managers to use every means available in making good forecasts. The growth of radicalism will become more and more marked unless these fluctuations are better controlled.

In the fall of 1921, President Harding called a conference to discuss the causes of and remedies for unemployment. It was soon recognized that the greatest distress of unemployment is caused by the fluctuations of business due to the business cycles. The conference appointed a committee to study the question of unemployment in relation to these business cycles, and many interesting facts are brought out in the full report of this committee, now available. In many industries men honestly believed that there was a lack of material and supplies, and that prices would continue to rise in 1920. Yet, if full information had been available, it would have shown a surplus accumulation of speculative stocks of goods. Had business been possessed of the true facts, comment on those facts would have prevented the spread of the idea that there was a much larger effective demand than actually existed.

Minimizing the Effect of Business Cycles

The committee points out that the present buying habits ought to be changed; business men should be induced to buy from hand to mouth when a boom is on, and to buy in larger quantities in a period of depression. This would prevent the over-stocking in boom times and the under-stocking that is always prevalent in times of depression. Since the only means of absolute demonstration of conditions is through the use of statistics, the committee urges that much more statistical study be given to the trends of each industry.

The committee also points out that the present tax laws tend to make companies extravagant in maintenance charges in good times, instead of putting men on maintenance work when production activity is low. Finally the committee recommends that every business man pursue the policy of systematic accumulation of reserves in times of prosperity for use in expansion and improvement in times of depression. It is to be hoped that the customers of the machine tool industry will take this advice to heart and change the buying habits which now make the machine tool industry most irregular.

Cooperation with the Department of Commerce

A valuable report was presented to the meeting by J. W. Carrel, vice-president and general manager of the Lodge & Shipley Machine Tool Co., who is chairman of the committee to cooperate with the Department of Commerce. Mr. Carrel pointed out that the Department of Commerce has much valuable information in its library and files which is available to machine tool builders interested in building up foreign trade. He emphasized the importance of obtaining accurate export trade information and advised the members of the association to take advantage of the facilities offered by the Department of Commerce.

The British Metal-working Industries

From MACHINERY's Special Correspondent

London, May 11

REPORTS from the principal engineering centers in the district covered by Coventry in the south to Sheffield in the north, afford many indications of steady trade improvement. Inquiries are plentiful, although for the present only a small proportion appear to mature into orders. However, the tendency as a whole is in the right direction, signs of returning confidence are to be observed in most quarters, and several development schemes of considerable importance, which have been held up owing to general trade depression, are now going forward. It is also apparent, despite frequent reports to the contrary, that strong efforts are being made to relieve the raw material shortage. In practically all districts where iron is produced there has been a striking reduction in the number of unemployed during the last two or three weeks. Numerous blast furnaces have been blown in, and several firms are producing pig iron to the full extent of their capacity. Steel making plants as a whole are also very busy.

The Machine Tool Industry

In the machine tool shops there is still a shortage of work. Some factories have turned temporarily to other lines of production and are doing fairly well, but the majority are depending upon the growth of their regular business, and their recovery rests upon a general renewal of industrial activity. In this respect conditions vary, and it is not surprising to find some works better employed than others. Even so, there are very few instances where an appreciable measure of improvement cannot be observed. As a matter of fact, in the writer's opinion, the situation is much better than outward appearances indicate. A good deal of work is now in the hands of the estimating and designing departments, which, while representing a necessary and very important stage of production, leaves the shops somewhat scantily employed.

One of the features of the present situation is the brisk demand for machine tools of a special character. Inquiries of this nature have developed into considerable proportions of late. In a number of cases the pressure of work is very heavy, and the difficulty of obtaining draftsmen of ability in sufficient numbers to cope with the work in hand is mentioned by several firms.

The demand for standard machines is also improving. Particularly is this noticeable in respect to gear-cutting and grinding machinery and similar tools used in the automobile industry. Many firms that previously bought gears from outside sources are now installing gear-cutting equipment of their own. In addition, the firms that supply gears to the trade are considerably increasing their equipment.

The Automobile Industry

As is usually the case at this time of the year, automobile manufacturers are fully employed, and the prospects of increased sales of machine tools in this direction are improving rapidly. At the present time, fully 50 per cent of the output of machine tools, in the Birmingham area at all events, is finding its way into the automobile factories. Among the more progressive motor car builders there is a distinct movement toward standardization. The number of models produced are being cut down to the minimum, and efforts are being made to use efficient tooling on the smaller variety of parts on a more intensive scale. By these means it is hoped that costs will be reduced.

Although the approval of standardization is by no means general in the automobile field, success has followed wherever it has been tried. One well-known factory is now producing a single type of power unit by intensive tooling methods and has effected a five-fold increase in production without adding to its overhead charges. This has enabled the price of the finished car in which the unit is embodied to be reduced to an exceptionally low figure, and at the present time the supply is far from equal to the demand. The management has therefore decided to double the present rate of output—a ten-fold increase over that of a year ago.

Effect of Requirements of Automobile Industry on Design of Machine Tools

Increased output demands machines of a highly efficient type, simple to operate and capable of high and continuous duty. An examination of many of the tools recently installed in motor car factories, or in process of construction at the makers' works, reveals the fact that such items as change-speed and feed-gear boxes have been eliminated. It is contended that as the machine will perform but one operation throughout its useful life, the only speed and feed necessary is that which is most suitable for the work in hand. Hence one or two pairs of change-gears take the place of an elaborate, but, under the circumstances, useless piece of mechanism. The control gear similarly has been reduced to the utmost simplicity, so that the machine may be operated with a minimum number of movements. On the other hand, it is obvious that the machines have been considerably improved in detail. Many parts are made from special heat-treated steels, and the shafts and spindles are invariably mounted in ball thrust or journal bearings, with the result that they remain accurate, absorb the minimum amount of power, and run for long periods without attention. These are the types of machines in which the motor car makers appear to be most interested, and providing the salesman can show, say, a 15 per cent saving over the existing method of machining, satisfactory business usually results.

Apart from the above, methods are being developed which are expected to have an almost revolutionary effect on existing methods of production. For the present it is not possible to make any very definite statement, as the development is still in its infancy. However, it is engaging the serious attention of well-known production engineers, and may be said briefly to consist of a system whereby a series of simple standard machine tool units, for instance, a drilling unit, a milling unit, a turning unit, and so on, may be arranged in line for the production of a single specified component. To machine the part, operations are subdivided to such an extent that each unit performs its work automatically, without any attention on the part of the operator other than changing the work. The type of jigs or fixtures used are designed so that setting and clamping of the work are performed, in many cases, with a single lever movement. Each unit is, of course, arranged on a common foundation closely adjacent to the next unit in sequence; hence there is very little time or effort lost in transferring the parts from one machine to another. Utilized to its full capacity, the above system obviously is only intended for production on a very large scale. On the other hand, it is capable of reducing costs to such an extent that the article produced can be marketed at a sufficiently low figure to attract a proportionately larger circle of new buyers.

Spark Tests for Steel

By S. P. ROCKWELL, Hartford, Conn., Consulting Metallurgist for the American Gear Manufacturers' Association

IT has long been the practice of toolmakers and hardeners to judge the grade of steel by observing the characteristics of the spark produced when a sample is held against an abrasive wheel. Charts have been prepared in the past showing "spark pictures" of high, medium, and low carbon steels, and of steel containing chromium, tungsten, and manganese. But it is only within the last two years that this method has been placed on a thoroughly practical working basis, so that it can be used as a reliable means for the inspection of steel. F. H. Starkey and D. H. Stacks, of Hartford, Conn., both of whom were for many years connected with the Whitney Mfg. Co., have been instrumental in developing the spark test method to a point where it has proved practicable for factory inspection. This method of inspecting the grade of steel depends largely on the inspector's ability to concentrate; anyone who is mentally alert, has good eyesight, is not color blind, and is conscientious in his observations, may become proficient in using it.

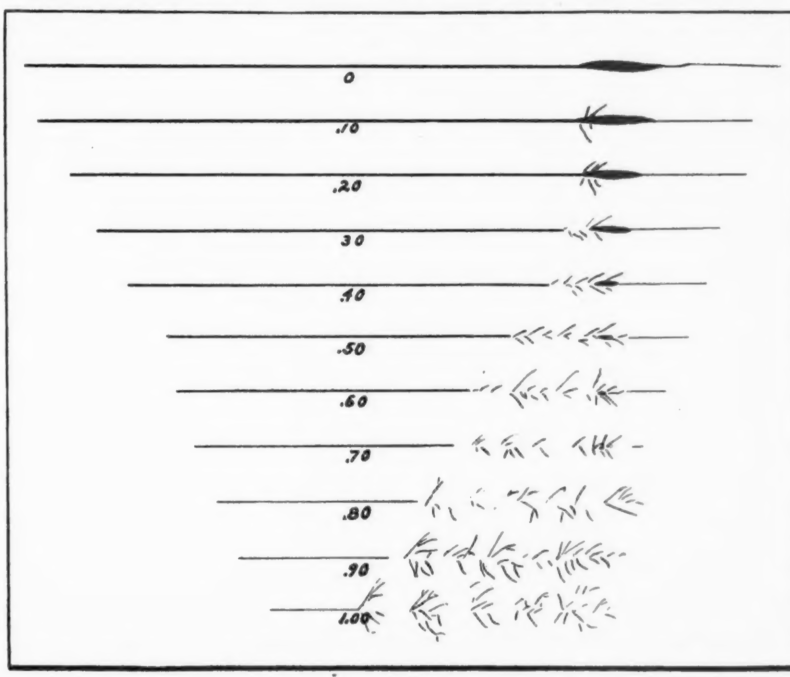


Fig. 1. Single Streaks in Spark Pictures of Carbon Steels with Different Carbon Content

It has been claimed that by simply observing the spark picture of a piece of steel it is possible immediately to determine the carbon content. As a matter of fact, this can rarely be done. It is doubtful if anyone could estimate within plus or minus 0.10 per cent of carbon, unless the grinding wheel speed and the type and grade of wheel have been standardized, and unless analyzed steel standards from the same heat as the steel being tested are available. But if wheel speed and wheel are standardized and a standard from the same heat is available, then it is possible to estimate the carbon content to within plus or minus 0.02 per cent for the lower carbon steels, and to within plus or minus 0.05 per cent for the higher carbon steels.

The carbon content of alloy steel may be determined as accurately as for the straight carbon steels, provided the percentage of alloying elements is not very high, as would be the case, for instance, in high-speed steel. In addition, the presence of other elements may be determined. The presence of chromium can readily be determined within ranges of 0.3 per cent; nickel below 1.5 per cent is somewhat difficult to determine, but nickel from 1.5 to 3.5 per cent is readily discerned. In tungsten steel, one may discover minute traces of tungsten, and also distinguish between 2 per cent, 5 per cent, and 8 per cent tungsten steel and higher. Nickel-chromium steels may be sorted by the spark test into grades agreeing with the S. A. E. specifications. The beginner, however, should become accustomed to the carbon steels first, for after he has become thoroughly conversant with these, the examination of other steels will be easier.

In looking at the spark picture produced by carbon steel, when pressed against an abrasive wheel, a series of streaks and explosions are in evidence. Fig. 1 shows, as accurately as a diagram can indicate it, the general appearance of the spark pictures of different classes of steel. The author has tried to obtain photographs to show the spark picture characteristics, but owing to the character of the light and the instantaneous appearance of the spark picture, these efforts have not been very successful. If we analyze a single streak in the spark picture produced by a medium carbon steel, we find a carrier line, a carbon explosion or crow's foot, an iron burning flash or bird's tongue, and a gas streak.

In chromium steels the explosion is different from that in a carbon steel. Each fork of the explosion breaks into another fork, and these explosion lines also curl, the appearance being similar to that of a daisy. The iron burning lines are much shorter than for carbon steel, and a little darker in color. With high tungsten steels the carbon explosion is absent. The color of the burning lines is dark red. As the tungsten decreases, carbon explosions appear with the characteristic daisy form that is associated with the chromium content, as mentioned. In manganese steel, the carbon explosions are bushy, somewhat like a bloom of wheat. Silicon below 0.20 per cent increases the appearance of bushiness.

Sometimes it is practicable to use colored glass filters for examining the sparks of alloy steels. These filters eliminate some of the different colors which are caused by the various elements in the alloy steel, and thereby make it possible to observe each element by itself.

Application of the Spark Test

The piece of steel to be tested should not be placed against the edge of the wheel. It has been found more satisfactory to place it against the side surface of the wheel at a point 1/4 to 1/2 inch from the outer periphery. There should be no obstruction in front of the spark, as it is generally easier to study the characteristics at a distance from the wheel at a point where the carrier lines are more separated. A black background should be used, against which the sparks can be clearly seen. The usual way, when testing is being done on a large scale, is to set the wheel in a black painted cabinet, so that the color and characteristics can be readily seen. The length of the spark has little to do with the

determination of the grade of steel, because the length usually depends on the size of the piece being tested and the method of pressing it against the wheel. The only difference in the method of testing hardened and annealed work is that more pressure is required to obtain the same length of spark with an annealed piece of work.

In determining the grade of a piece of steel, estimate roughly the carbon content from the spark picture characteristics. If it appears to be about 0.20 per cent, obtain standards having 0.10 and 0.30 per cent carbon. By testing these pieces, and testing the unknown sample, immediately after, it is easy to determine whether the sample being tested is nearer the 0.30 per cent carbon content or the 0.10

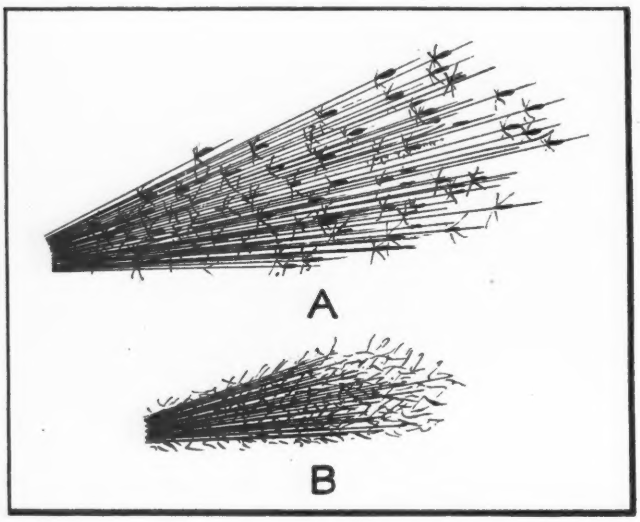


Fig. 2. (A) Spark Picture of Medium-carbon Steel; (B) Spark Picture of High-carbon Steel

per cent carbon steel. The test may be continued by obtaining a 0.20 and 0.25 per cent carbon standard, and comparing the spark pictures of these standards with the spark picture of the sample being tested; in this way, it is generally possible to determine the carbon content quite accurately. For accurate work, analyzed standards of the same heat of steel should be used, but for rough determinations, standards of the same type of steel are satisfactory. Such standards should always be kept on hand, varying by 0.05 per cent carbon.

When a new lot of steel is received in the shop, half a dozen bars are selected, the sparks of each observed, and pieces cut from the bars having the lowest and the highest carbon content, as shown by the spark test. These samples are analyzed, and the analysis is stamped on the samples, after which they are used as a standard. Generally speaking, a piece of steel should never be chemically analyzed without saving a piece of it with the analysis stamped on it. These standards of known composition are frequently of great value. An inspector of material who uses reliable standards to compare with, can almost always accurately determine the carbon content of steel without difficulty.

* * *

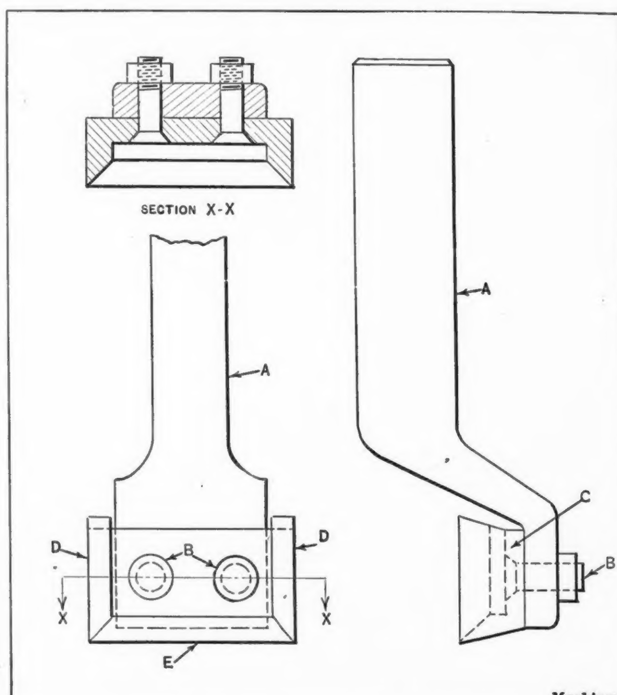
Among the things necessary to place the railways in a position to handle the constantly increasing traffic of the country, Howard Elliott, chairman of the Northern Pacific Railway Co., mentions improved designs of locomotives and cars to provide the maximum capacity and strength with a minimum of dead weight, a better supply of well designed repair plants equipped with high-power, rapid-working machine tools, and better equipment in all the shops and roundhouses where mechanical work is performed. The necessity for these improvements has long been recognized by everyone familiar with machine shop work, and the sooner the railways are able to put this program into effect, the better it will be both for their own economical status and for the public, who will gain in improved service.

TOOL FOR REMOVING BABBITT FROM LOCOMOTIVE CROSS-HEAD SHOES

By H. H. HENSON
Machine Shop Foreman, Southern Railway Co., Chattanooga, Tenn.

The tool shown in the accompanying illustration is intended primarily for use in removing babbitt or any other soft bearing metal from locomotive cross-head shoes. It is designed to accomplish its purpose in such a manner as to save time and insure the thorough removal of all loose metal so that the metal which replaces that removed will not be loosened after the shoe has been relined. Referring to the illustration, it will be noted that the tool shank or holder *A* is offset at the lower end. The cutter which is attached to the offset end of the holder by bolts *B* has its horizontal and vertical cutting edges approximately on the center or fulcrum line of the tool. This feature has a tendency to prevent chatter or "digging in."

The cutter is preferably made by electrically welding pieces of metal together that have been previously formed to the required shape. The pieces which are welded together consist of the base *C*, the two carbon steel tool bits *D*, which form the vertical cutting edges that project from the base of the cutter, and the horizontal bit *E* that projects from the end of the cutter base. The cutter is ordinarily hardened or tempered to a degree which permits it to be sharpened by a fine mill file.



Tool for removing Babbitt from Cross-head Shoes

The tool here described, which is the patented invention of the writer, has been especially designed to take cuts from 4½ to 6 inches wide.

* * *

MEETING OF SOCIETY FOR TESTING MATERIALS

The twenty-sixth annual meeting of the American Society for Testing Materials will be held at the Chalfonte-Haddon Hall Hotel, in Atlantic City, N. J., June 25 to 29, when the following subjects will be taken up: Non-ferrous Metals and Alloys; Corrosion and Fatigue of Metals; Magnetic Analysis; Wrought and Cast Iron; Coal and Coke, Heat-treatment; and Methods of Testing Steel. These subjects will all be dealt with during the days June 25 to 27. The later sessions relate to the testing of materials in non-metal-working fields. Further information may be obtained from the headquarters of the society, 1315 Spruce St., Philadelphia, Pa.

Machining Vulcanized Fiber

By A. B. EASTMAN, Sales Engineer, Diamond State Fibre Co., Bridgeport, Pa.

A SHARP tool with plenty of clearance will contribute more to the successful machining of vulcanized fiber than any other one item. Machinists accustomed to working iron and steel are inclined to think that a tool will stay sharp indefinitely on fiber, because it is apparently a softer material. On the contrary, vulcanized fiber is an extremely hard and tough material, and to obtain the best results it is necessary to keep the cutting edges in good condition. As fiber is slightly elastic, it is inclined to crowd against the back of the tool, so that plenty of clearance is essential. As a general rule, tools for cutting fiber should be ground about the same as those used for brass.

Milling Fiber

In milling vulcanized fiber with standard milling cutters, high speeds and feeds will give the best results, both as regards finish and length of time between grinds. As a typical instance, small gears of 8 to 10 diametral pitch can be cut best with a spindle speed of about 550 revolutions per minute and a table feed of about 6 feet per minute. Two-bladed fly cutters for formed work should be run at higher speeds, but with a slower feed. Considering the difference in price, we have found carbon steel cutters better for milling fiber than high-speed steel cutters.

Turning and Threading

When vulcanized fiber disks or rings on arbors are to be turned, high-speed steel bits will give better results than carbon steel. In turning disks 2 7/8 inches in diameter by 3/8 inch thick, a spindle speed of 325 revolutions per minute and a feed of 8 inches per minute have been found satisfactory. A double tool-holder is used, carrying a high-speed steel roughing bit and a diamond finishing tool. The roughing tool leaves about 1/64 inch on a side for the diamond to remove. The finished size is kept within 0.005 inch without difficulty.

In threading vulcanized fiber tubes, rods, and disks, the best results are generally obtained with self-opening dies. When chasers for these dies are to be bought, it is well to specify that no chamfer is wanted at the front, as the omission of this chamfer will prolong the life of the chasers. Chasers with an extension in front can be bought at little additional cost, and will outlast two or three stock chasers.

Drilling and Tapping Fiber

Drills should be run at high speeds for vulcanized fiber; sizes 1/4 inch and under should be run at from 2500 revolutions per minute up to 10,000 revolutions per minute, and larger sizes in proportion. The best results are obtained by running at the highest speed that can be used without burning the tool. Dubbing the lip of the drill and giving it plenty of clearance will cause it to cut freely and tend to prevent splitting. Drills should not be forced, as this tends to split the material. If the drills are kept sharp, they will require but a slight pressure to cut. Many of the troubles in drilling are caused by dull tools; if necessary, they should be reground every ten or fifteen minutes. The operator can save time by keeping a half dozen ground tools on hand.

A drill often cuts smaller than itself in fiber, so that it is well to try out the material before ordering jigs. Fiber should be drilled perpendicular to the grain, whenever possible; otherwise the material is likely to split. If it is necessary to drill parallel to the grain, care must be exercised to prevent splitting. The land on a drill, especially in the large sizes, is inclined to wear off and cause smoking and burning; when the drill is sharpened, the worn part should be ground out.

In drilling holes to be tapped, a larger sized drill should be selected than is necessary for iron or steel. This practice will reduce tap breakage and also give a full thread. It is best to experiment before drilling any large quantity of work or making up jigs.

Bending and Forming

Fiber should always be bent parallel to the grain (the long way of the sheet), because it is difficult to bend fiber across the grain without breaking it. The general practice is to soften the material (more or less) by immersing it in hot or cold water until sufficiently tempered, and then drying it in heated forms under enough pressure to keep the shape desired. The fiber should be left in the heated forms long enough so that it will retain the desired shape after cooling. However, heated forms are not always necessary.

If the material can be steamed, instead of immersed, it will require less time to set. Angles can be bent in bending brakes fitted with electric, gas, or steam heat. Special pieces can be formed on a hot plate in cast-iron forms, under pressure of a hand-operated spring plunger. In making up the top and bottom forms, some allowance should be made for the fact that fiber swells slightly when it is soaked or steamed. Tubes can be bent by softening in hot water, filling with sand, and clamping in wooden or metal forms, after which it is necessary to dry them at about 150 degrees F.

Punching Fiber

Fiber can be easily blanked, pierced, and shaved on ordinary punch presses. For blanking and piercing thin material, the punch should be a neat fit in the die, while for stock 1/4 inch thick, a difference of about 0.008 inch will give the best results. When a rough edge is not objectionable, fiber can be blanked out up to 1/4 inch thick. When heavier stock is blanked, it is likely to "check in" too far and cause considerable wastage, although some material up to 7/16 inch in thickness can be blanked.

Smooth edges can be obtained by forcing blanked or sawed fiber blocks through a hollow shaving cutter of the desired shape. The edges of the cutter should have a slant of about 45 degrees. Sharper angles will often give smoother edges, but the cutter will not last so long as otherwise. A better finish can be had by using a roughing and a finishing cutter. It is generally necessary to allow from 1/16 to 1/8 inch all around for shaving, according to the shape of the pieces. When trouble is encountered by checking of the stock while blanking or shaving, softening the fiber by heating will often overcome the difficulty.

Dies and cutters for fiber can be made without any clearance for 1/2 inch or more below the cutting edge. The bottom of the die may be counterbored within 1/2 or 3/4 inch of the top to facilitate machining. Such a die will not change its size in grinding and will give better results than a die with clearance to the cutting edge. If the cutting edge of a shaving cutter is mouthed out very slightly with a fine oilstone, the stock will bind slightly in passing through, which will tend to polish the edges smoothly.

Sawing Fiber

Vulcanized fiber can be sawed to a smooth polished edge with a hollow-ground circular saw, without set to the teeth. A 14-inch saw, from 1/8 to 5/32 inch thick, and with 110 to 120 teeth, is a good saw for general use. This saw should be run at at least 2500 revolutions per minute, to obtain the best results. Band saws with 5 1/2 points per inch and 19 gage thickness are generally used for fiber. The widths vary from 1/4 inch for scroll-sawing to 1 1/4 inches for heavy sheet sawing. A saw should run at about 4000 linear feet per minute, or from 350 to 500 revolutions per minute for a 36-inch wheel.

Machining Fiber in Automatic Machines

Vulcanized fiber tubes and rods can be successfully machined in automatic screw machines. When tubes of the correct size can be obtained, they will generally give better results than rods. It is our practice to use the following feeds on automatic screw machines:

Drilling	0.007 to 0.010 inch per revolution
Turning	0.010 to 0.015 inch per revolution
Forming	0.0015 to 0.002 inch per revolution
Cutting off	0.002 to 0.003 inch per revolution

For trial purposes and for short jobs, the cams for Brown & Sharpe machines can be band-sawed from vulcanized fiber.

The data given in the foregoing is the result of over twenty years experience which the Diamond State Fibre Co. has had in developing the best methods for machining vulcanized fiber.

FURTHER INFORMATION ON MACHINING FIBER

Another manufacturer specializing in fiber products states that in punching fiber it is best to use a punch and die with flat surfaces on the top of the die and on the bottom of the punch. The punch should be made a certain amount greater in diameter than the hole required in the fiber, because the material "comes back" a certain amount after punching; it has been found satisfactory to make the piercing punch 0.008 inch larger in diameter than the hole required for each 1/8 inch in thickness of the fiber sheet. When washers or disks are punched from sheet stock and the outside dimension of the piece punched out is the important factor, the procedure is reversed, and the punch and die are made about 0.008 inch per 1/8 inch in thickness of the fiber sheet smaller than the diameter of the piece required. It has been found impracticable to use solid punches on fiber sheets over 1/4 inch in thickness, because the material "checks" badly when punched.

Ordinary twist drills are suitable for drilling fiber, high-speed steel drills being preferred when quantity production is required. The drills must be sharpened more often than when metal is drilled. If the drill is not kept sharp and does not have plenty of clearance, it will bind and burn. Feeds of from 0.010 to 0.020 inch per revolution of the drill are about right for drilling fiber, depending on the size of the hole to be drilled. No cutting lubricant is necessary. The speed of the drill should be about equal to the maximum recommended for drilling steel.

The best cutting speed for turning fiber has been found by the firm quoted to be about 500 feet per minute, using a fairly light feed so as not to tear the stock. The tools should be ground with a slightly greater clearance than is used for turning metals. No cutting lubricant is required.

In sawing fiber, either a circular saw or a band saw may be used. A saw with five points to the inch has been found best for this work. When an exceptionally smooth surface is required, circular saws with little or no set to the teeth should be used. These saws should be hollow-ground for clearance. When sawing out rough blocks of fiber, a saw with considerable set to the teeth is used. For rough work, fiber can be cut with an ordinary squaring shear.

DIES FOR PRODUCING METAL SPOOLS

By S. A. McDONALD

The dies shown in Figs. 2 and 3 were designed to produce the flanges and the hub, respectively, of the metal spool shown in the upper sectional view of Fig. 1. This spool is used to hold adhesive tape, and is made from sheet tin. The lower view in Fig. 1 shows the flanges and hub of the spool in position on the assembling dies ready for the assembling operation. The die shown at the left in Fig. 2 blanks and punches the hole in the spool ends, and flanges and draws the outer edge preparatory to the curling operation, which is performed in the die shown in the view at the right-hand side of Fig. 2. It will be noted that a slight taper is given to the punch *C*. The corresponding taper produced on the blank tends to cause the edge of the blank to make contact with the tapered portion of the curling punch, as shown in the enlarged view at *A*, so that it is properly guided up into the curling portion of the punch. If the blank were not given this taper, the edge would be likely to spring back, as indicated at *B*.

Another advantage gained by tapering the die and the punch as shown is that it eliminates the need for a stripper

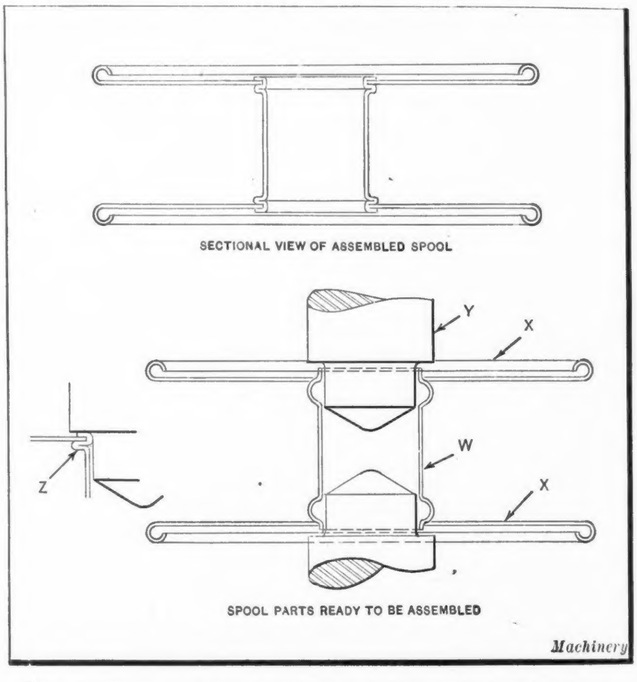


Fig. 1. Views showing Assembled and Unassembled Metal Spool

ring to force the work up from the punch *C*. The piercing punch *D* is driven into the blanking punch *E*. The knock-out pad *F* is actuated by the knock-out *G*. The die-plate *H* is turned to fit the forming punch *C*, which also acts as the piercing die for the central hole in the spool end or flange. The cutting or blanking die *J* is held in alignment by the forming punch *C*. Both the forming punch and die *J* are secured by fillister-head screws *K*. The curling punch shown in the view at the right-hand side of Fig. 2 is provided with a pilot *L* which is a loose fit in the hole in the blank to be curled. This centralizes the blank in its nest *M*. After the edge of a blank has been curled, the blank is pushed out of the way by the succeeding piece. A guard (not shown) prevents the operator from placing his fingers under the punch.

The stock from which the hubs are made is fed in strips into the die shown in the view at the left-hand side of Fig. 3. The cutters *N* and *O* cut off the stock to the correct length when the strip is located against the stop *P*. The blank is carried down into the forming die *Q* by the punch *R* so that the ends are bent up to form quarter circles having a radius equal to that of the hub. Two beads are also formed in this operation running the entire length of the piece. A spring pad *S* brings the stock up to the feeding position when the punch has cleared the die.

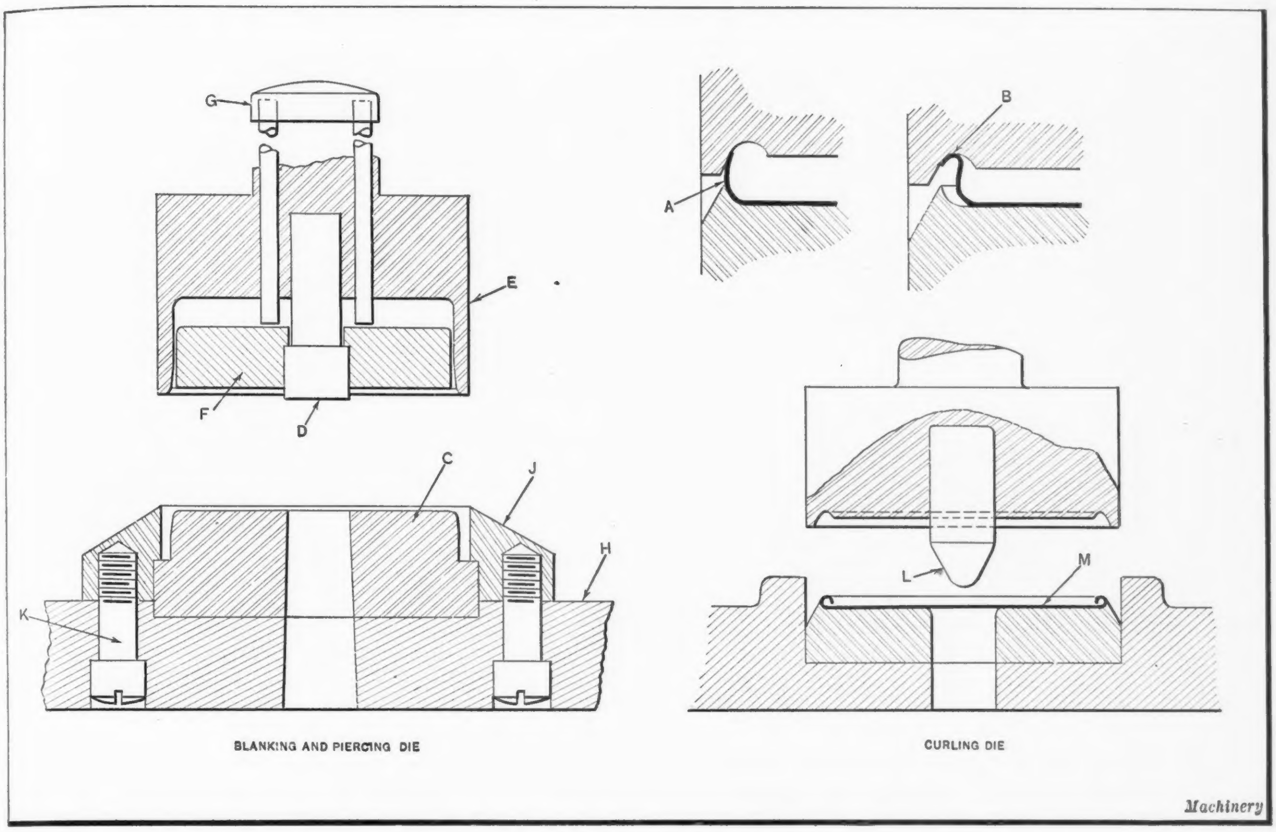


Fig. 2. Dies for blanking and curling Ends of Metal Spool shown in Fig. 1

The second operation on the hub is performed in the die shown in the front and side views at the right-hand side of Fig. 3. The beadings formed in the preceding operation are located in grooves cut in die *T*. A mandrel *U* is secured to a holder *V* which fits the slide of the press. The mandrel bends the blank into a semi-circular shape, and throws up the ends around the mandrel so that the hub is completely formed to the shape indicated at *W*, Fig. 1. The hub is pulled off the mandrel at the end of the stroke, the open seam allowing the piece to be sprung sufficiently to permit it to be drawn over the beads. The assembling of the hub *W* and ends *X* is done in a foot press. When the upper pilot *Y* is brought down, it aligns the three parts that make up the spool. A continued movement of the pilots causes the ends of the hub to collapse so that they clinch the flanges or spool ends in place, as indicated in the detail view at *Z*.

* * *

An interesting use is being made of motion pictures in advertising American bridges abroad. The Rothacker Film Co. of Chicago, Ill., has produced a motion picture for the Strauss Bascule Bridge Co. of the same city, which shows the development, step by step, of different types of swing bridges, and finally the latest type of highly developed bascule bridges, such as are in use, among other places, on the Jackson Blvd. in Chicago. A number of other designs of new bascule bridges are also shown.

Fig. 3. Dies employed to produce Hubs for Metal Spool shown in Fig. 1

Cutting Worm-Gears

Use of Ordinary Hob and Radial In-feed—Fly-cutter Method—Use of Tapering Hobs

By FRANKLIN D. JONES

WORM-GEARS are usually cut by a generating process, although the formed cutter method has been used to a limited extent for such special operations as cutting certain classes of dividing wheels. The machines used for cutting worm-gears include ordinary milling machines, gear-hobbing machines of the type adapted to cutting either spur, spiral, or worm gearing, and special machines designed expressly for cutting worm-gears. The general methods employed are (1) cutting by using a straight hob and a radial feeding movement between hob and gear blank; (2) cutting by feeding a fly cutter tangentially with relation to the worm-gear blank; and (3) cutting by feeding a tapering hob tangentially. These three methods will now be considered.

Use of a Straight Hob and Radial Feeding Movement

When worm-gear teeth are generated by a straight or cylindrical hob, the latter is centered relative to the curved throat of the worm-gear blank, as shown by the end view of diagram *A*, Fig. 1; then as the gear blank and hob rotate together at the proper ratio, the hob is fed inward radially just far enough to form teeth of the right height. These worm-gear teeth on the mid-section x–x correspond to the teeth of an involute spur gear of the same pitch and diameter. The hob represents a standard rack for involute gearing, and generates the teeth the same as in hobbing a spur gear, except that a radial feeding movement is employed in order to form concave teeth.

When worm-gears are hobbed on an ordinary milling machine the teeth are first formed roughly by a gashing operation, performed preferably by means of an involute gear cutter of a number and pitch corresponding to the number and pitch of the teeth in the worm-gear. A hob is then placed in mesh with this gashed blank, and the rotation of the hob causes the blank to revolve as the hob is gradually fed in to the required depth. In using a gear-hobbing machine, this preliminary gashing is unnecessary, because the hob- and work-spindles are connected indirectly through gearing, so that the rotation of one relative to the other is positive and at the proper ratio.

A hob used for worm-gears should have the same lead and helix angle at the pitch circle as the worm that the worm-gear is to be driven by. Hob teeth, however, should preferably differ from the worm thread in regard to the height of the teeth above the pitch line and the depth below this line. The hob tooth addendum should be made equal to the worm dedendum, and the hob tooth dedendum equal to the worm addendum. In other words, the hob is made the reverse of the worm, as far as height above and below the pitch circle is concerned, so that the hob diameter is larger than the worm diameter an amount equal to twice the clearance space required between the worm and wheel. In using such a hob, the worm-gear teeth will be given the proper clearance at the root, and if the throat diameter of the blank is too large, the tops of the teeth will be trimmed off to the correct height. The hob is a duplicate of the worm as regards the number of threads; that is, single-threaded hobs are used for worm-gears intended for single-threaded worms, and multiple-threaded hobs for worm-gears that are to be driven by multiple-threaded worms.

Cutting Worm-gears by Fly-cutter Method

Worm-gears are frequently cut by using a fly cutter, which is shaped like a hob tooth of corresponding pitch. This fly cutter is set to the full-depth position (unless allowance is made for a finishing cut), and it is given a tangential feeding movement relative to the worm-gear blank, as indicated by diagram *B*, Fig. 1, at the same time revolving at the proper ratio relative to the rotation of the worm-gear blank. A common method of obtaining this tangential movement is to mount the cutter-bar on a slide which is given a slow feeding movement, so that the cutter passes from one side of the gear blank to the other. If the worm-gear has, say, 40 teeth, then the cutter-bar will make 40 revolutions to one of the wheel, plus or minus a slight variation referred to later. As the cutter begins to work on one side of the blank, forty shallow grooves are formed during the first revolution, and these are gradually made wider and deeper as the fly cutter feeds across the blank from one side to the other, thus completely forming the teeth, unless a light finishing cut is taken afterward.

Now in order to cut worm-gear teeth of correct shape, the fly cutter must be made to advance along a helix (see diagram) or as though it were moving along the thread of a worm similar to the one that the worm-gear is intended for. When a straight hob is used, as shown at *A*, each tooth of the hob rotates in a fixed plane, but as quite a number of teeth are spaced along a helix, the action of the hob is like that of a worm, and the successive cutting teeth keep in step

with the worm-gear teeth as the hob and gear are revolved together at the correct ratio. When a fly cutter is used it is evident that it must perform the work done by a series of hob teeth. To accomplish this, the fly cutter, as it feeds tangentially, is revolved at such a rate relative to the worm-gear, that the cutter gradually passes the positions which successive hob teeth would occupy; consequently, the same general effect is obtained with a fly cutter as with a hob, although the worm-gear teeth are shaped somewhat differently, as compared with a straight hob.

To further illustrate the action, assume that successive hob teeth are designated by numbers 1, 2, 3, etc. Then when the fly cutter is in the position occupied by hob tooth No. 1, it will perform the work of this hob tooth. Similarly, when the fly cutter has advanced to coincide with the position of hob tooth No. 2, it performs the work of this tooth, and so on for the entire series. This feeding movement is necessarily very slow, because the fly cutter has to take heavy cuts, especially in passing the center or full-depth position.

While the fly-cutter method is slow, as compared with hobbing, it has two decided advantages which account for its general use: First, a very simple and inexpensive cutter may be used instead of an expensive hob. This is of great importance when the number of worm-gears is not large enough to warrant making a hob. Second, with the fly-cutter method, it is possible to produce worm-gears having more accurate teeth than are obtainable by the use of a straight hob, provided, of course, that the fly-cutter method is properly applied.

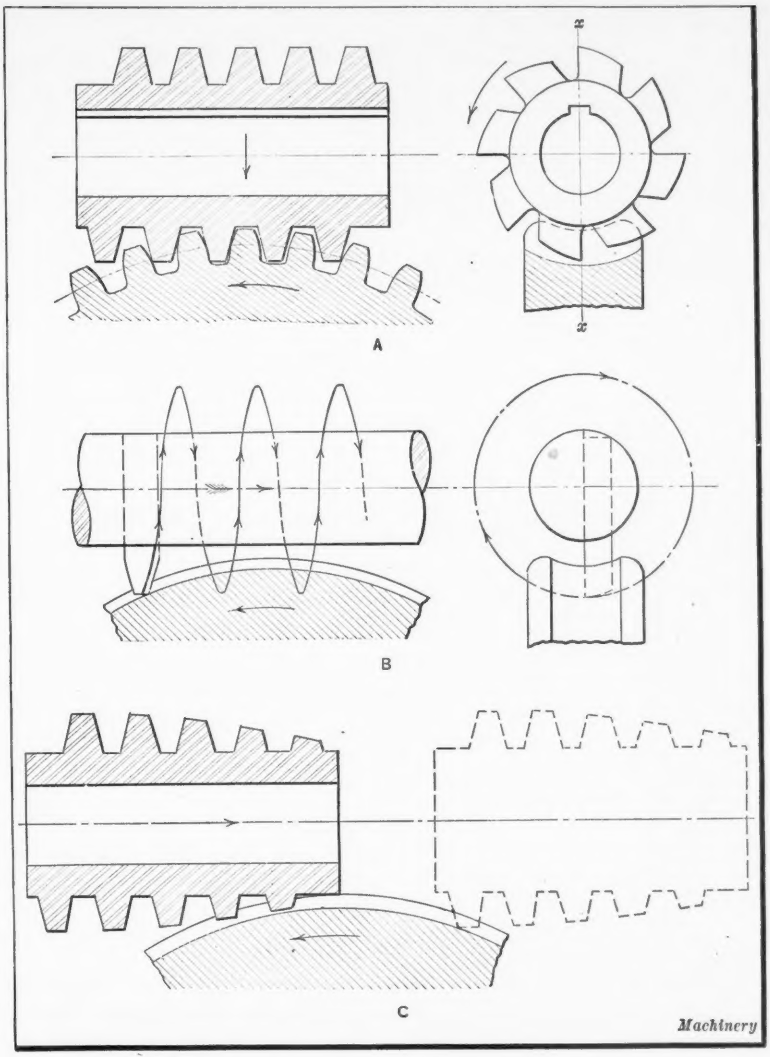


Fig. 1. Different Methods of cutting Worm-gears illustrated diagrammatically

Taper Hob with Tangential Feeding Movement

Another tangential method of cutting worm-gears involves the use of a taper hob, which is set to the full-depth position at one side of the blank, and fed tangentially across it as illustrated by diagram *C*, Fig. 1. The use of a taper hob makes it possible to cut worm-gears more rapidly than by means of a fly cutter, and also very accurately, provided the hob itself is accurate. The taper hob method also increases the rate of production as compared with the use of straight hobs which are fed in radially.

In the taper-hob method, the rotation of the hob relative to the blank, as the hob moves tangentially, is such as slowly to advance or screw the hob along its own thread. The action of the hob is the same as that of a fly cutter, and machines adapted for the fly-cutter method may also be equipped with taper hobs. The leading teeth on the hob are tapering, as indicated by the diagram, and they should be designed to increase progressively in width as well as in height from the small to the full size end. The tapering or leading end performs a roughing operation, whereas the full sized teeth take light finishing cuts, thus preserving their accuracy and insuring well-formed teeth. The tangential feeding movement continues until the large end of the hob passes out of contact on the side opposite the starting point, as indicated by the dotted lines of the illustration.

Taper hobs are especially adapted for cutting worm-gears that are to mesh with worms having large helix angles; they are also preferable for worm-gears having large face widths in proportion to the worm diameter. Worm-gear teeth are generated more accurately with a taper hob than with a straight hob that is given a radial feeding movement. This is because the radial method brings the worm-gear teeth into contact first with the outer ends of the hob teeth and then with the inner portions which have smaller helix angles; consequently, the hob removes parts of the teeth on the sides which would bear upon the worm thread if they were of perfect form. Therefore the bearing is theoretically at the center, although notwithstanding this fact, worm-gears cut by the radial method are extensively used and are satisfactory for a great many applications of worm-gearing. If a taper hob is used, a better bearing contact is obtained, especially for large helix angles and face widths, because such conditions are particularly unfavorable to the radial straight-hob method.

When a worm-gear is cut by using a straight hob and a radial feeding movement, the machine is geared so that the hob and work revolve according to the ratio of the number of threads in the worm and the number of teeth in the worm-gear. For instance, if a worm-gear has 50 teeth and is to mesh with a single-threaded worm, the machine will be so geared that the hob makes 50 revolutions to one of the worm-gear blank.

If a fly cutter or taper hob is used, however, it is necessary to take into account the tangential feeding movement, and to so alter the ratio as to cause the cutter to follow a helical path. If the worm-gear is to have, say, 50 teeth, then the ratio must be a little greater than 50 to 1, assuming that the feeding movement of the cutter is against the direction in which the work is rotated, as shown by diagram *B*, Fig. 1. If the tangential feeding movement and the rotation of the work are in the same direction, then the ratio would be somewhat less than 50 to 1.

In order to illustrate the action more clearly, suppose the ratio is exactly 50 to 1 and that the tool is moved to the right until the point begins cutting a series of shallow

grooves around the rim. It is apparent that if the tool is not moved farther to the right, it will simply rotate in unison with the blank and pass through the grooves without any further cutting action; but if the cutter-bar is again given a tangential feeding movement without changing the 50 to 1 ratio, the tool will no longer match with the grooves, but will begin to widen them by cutting away the right-hand sides in feeding to the right as indicated by the diagram. A continuation of this feeding movement would simply cut away the blank without forming teeth.

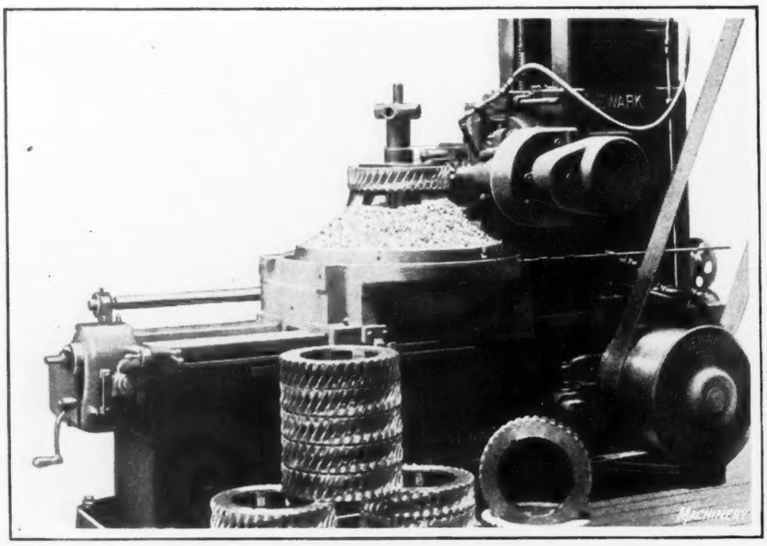


Fig. 2. Hobbing Worm-gears to be used with Five-threaded Worms

This side-cutting action is due to the fact that a given tooth groove comes around to the same position each time the cutter makes fifty revolutions, but the cutter, owing to its advancing movement is continually arriving at different positions relative to the work. This may be prevented (assuming that the cutter is advancing against the direction of rotation) either by decreasing the speed of the work or by increasing the speed of the cutter, which produces the same result.

For instance, the cutter shown by diagram *B* should, for the movements of the tool and work indicated, revolve somewhat faster than the 50 to 1 ratio for cutting a 50-tooth worm-gear. On the contrary, if the feeding movement were in the same direction as the rotation of the work, the ratio should be decreased. This change in ratio varies according to the relation between the rotary and feeding movements of the cutter and the rotation of the work, and its practical effect is to cause the cutter to change its position successively relative to the work, the same as though it were moved to numerous positions along a helical curve.

How the Actions of the Cutter and Work are Controlled

The proper relative movements of the work and cutter may be obtained in different ways, but as a rule they are controlled by means of change-gears in conjunction with a differential mechanism. The latter is not indispensable, but is generally considered desirable. According to one arrangement, motions from the shaft driving the cutter-bar and the shaft driving the tangential feed-screw are combined by the use of differential gearing to rotate the work at a rate that compensates for the tangential feed.

If a differential is not used, the mechanism of the machine can be simplified somewhat, but since the feeding movement of the cutter-bar and its rotation relative to the work-spindle are controlled by positive gearing, any change of gearing to give a different rate of feed must be accompanied by a corresponding change in the gearing that determines the ratio of rotation between the cutter- and work-spindles. This is not the case when a differential is used.

Examples of Hobbing with a Straight Hob

An example of worm-gear hobbing on one of the machines built by the Newark Gear Cutting Machine Co., is shown in Fig. 2. The worm-gears are made of bronze and have 38 teeth of 1⅛ inches circular pitch, and a 3-inch face width. These gears are to be used with five-threaded worms, which accounts for the fact that the teeth have an inclination, relative to the axis, of 26 degrees. Ordinarily, in cutting a worm-gear having a large axis angle, the hob is fed tangentially to obtain a nice finish and prevent forming flats on the teeth. An interesting feature of the operation shown is that it was possible to feed the work straight into the hob without a tangential feeding movement, because the number of teeth in the gear, the number of threads on the worm, and the number of hob flutes were all prime to each other.

The heading illustration shows an example of worm-gear hobbing at the plant of the Philadelphia Gear Works. This is a cast-steel worm-gear having 47 teeth of 2¼ inches circular pitch and a 4½-inch face width. The machine used has a horizontal cutter-spindle and a vertical work-spindle which are revolved together at the proper ratio through change-gears. The work-spindle is carried by a slide which is given the necessary feeding movement for sinking the hob in to the full-depth position.

The Farwell gear-hobbing machine which is built by the Adams Co., Dubuque, Iowa, is shown hobbing a worm-gear in Fig. 3. This is a cast-iron worm-gear having 76 teeth of 3 diametral pitch. The hob speed was 57 revolutions per minute, and the inward feeding movement of the work-table 0.050 inch per revolution of the gear blank. This worm-gear was hobbed to the full depth in twenty-four minutes, without preliminary gashing of the gear blank.

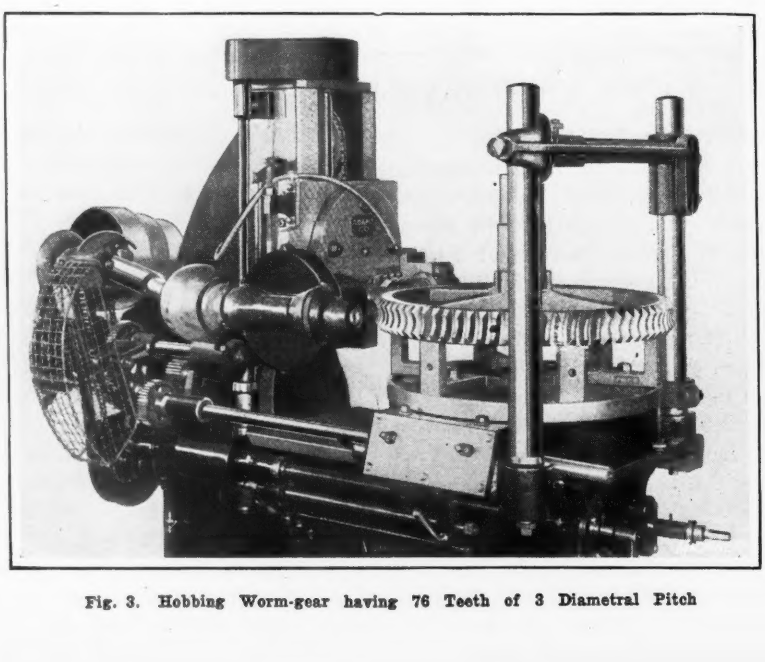


Fig. 3. Hobbing Worm-gear having 76 Teeth of 3 Diametral Pitch

The duplex type machine, which is shown in Fig. 4, is employed by Edwin Harrington, Son & Co., Inc., Philadelphia, Pa., for cutting spur as well as worm gears. When it is applied to spur gears the machine may be equipped with two formed cutters which operate on both sides of the gear simultaneously so that the gear is finished after it is indexed a half revolution. For worm-gears a hob is applied to one side in the usual manner, as shown in the illustration. The particular worm-gear

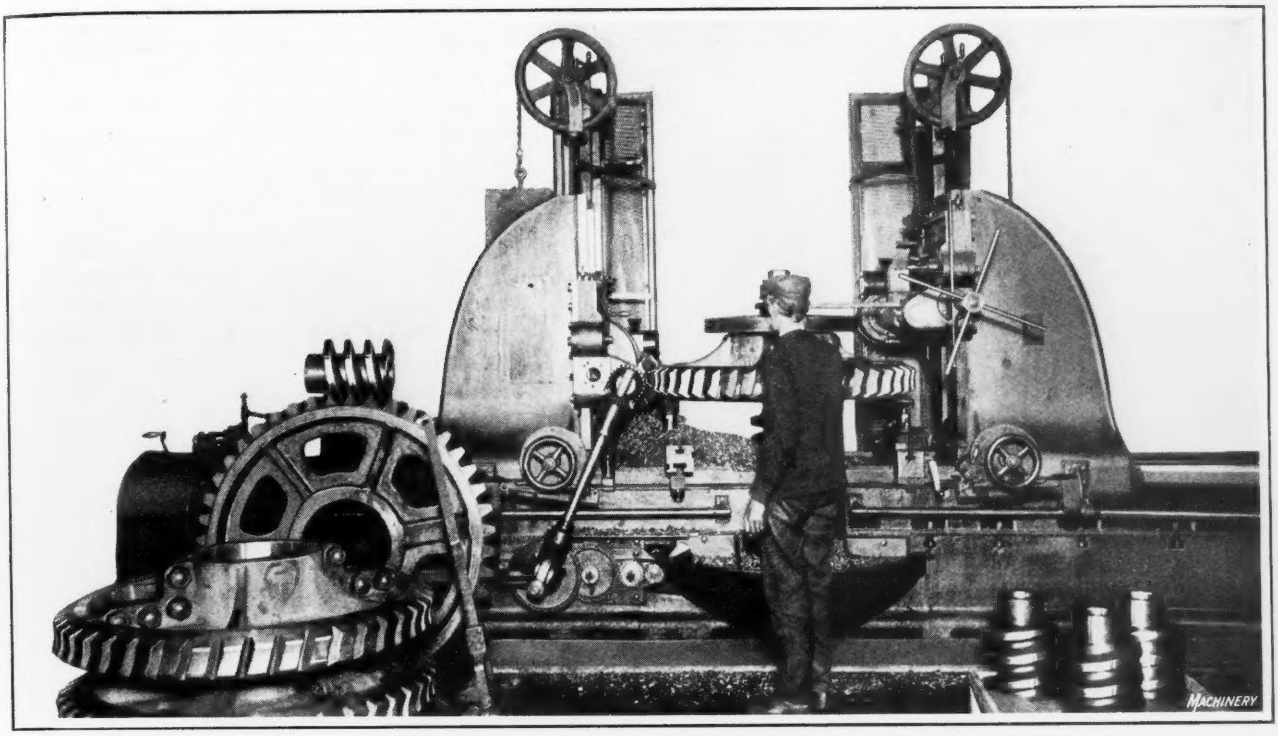


Fig. 4. Duplex Type of Machine used for cutting both Spur and Worm Gears

shown is made of manganese bronze and has 44 teeth of $3\frac{1}{2}$ inches circular pitch.

Application of the Fly-cutter Method

Worm-gears intended either for single- or for multiple-threaded worms may be cut by the fly-cutter method previously described. Fig. 5 shows a close-up view of a Newark machine cutting a cast-steel worm-gear at the plant of the Philadelphia Gear Works. This gear has 47 teeth of $2\frac{1}{4}$ inches circular pitch. Owing to the size of the fly cutter required for this pitch, it was made with an attached blade instead of being formed in one solid piece. This blade is held in position by a single cap-screw, and the lower end is supported and centered by engagement with a shallow groove and by projections on each side which prevent shifting laterally. The machine is the type having differential gearing for combining in the work-spindle a rotation modified by the rotation of the cutter-bar and its lateral feeding movement.

The cutting of a bronze worm-gear on a Newark hobbing machine equipped with a tangent-feed cutter-slide is shown in Fig. 6. This is another example of worm-gear cutting by the fly-cutter method. This particular worm-gear has 57 teeth of $1\frac{3}{4}$ inches circular pitch, a pitch diameter of 31.751 inches, and a 4-inch face width. This gear is to mesh with a right-hand double-threaded worm. As the fly tool representing a section of the worm thread passes through every point that the worm would occupy, the teeth generated by this method are theoretically correct. This worm-gear was completed by taking two cuts. While it is possible to finish worm-gears of fairly coarse pitch by taking a single cut, better results are obtained when two cuts are employed.

Use of Multiple Cutters as Substitutes for Multiple-threaded Hobs

Worm-gears intended for use with multiple-threaded worms may be generated by using a cutter-bar having as many cutters as there are threads in the worm. For instance, if the worm is double-threaded, two duplicate fly cutters spaced 180 degrees apart could be used for cutting the worm-gear, whereas for a triple-threaded worm three equally spaced cutters might be employed. While a single fly cutter may also be used for multiple work by indexing the cutter-bar, there is an advantage in having a cutter for each worm thread in that all the worm-gear teeth are formed during one passage of the cutter-bar. This may be impracticable, if the worm has quite a large number of threads, and sometimes only part of the number of threads in a worm are represented by fly cutters. In this case, the work is indexed for finishing the remainder of the worm-gear teeth, the principle being the same as when using a single fly cutter for cutting a worm-gear for a double-threaded worm.

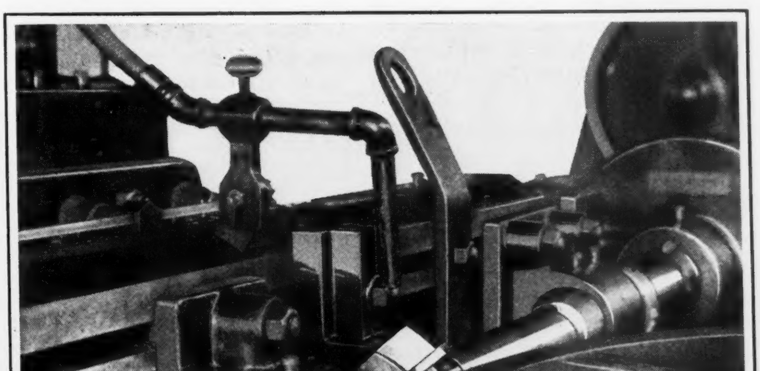


Fig. 5. Cutting a Worm-gear by the Fly-cutter Method

Some of these multiple-threaded worms resemble helical gears, and such worm-gearing is frequently used instead of helical or spiral gears. The application of multiple-threaded worm-gearing in preference to helical gearing is particularly desirable when there is considerable power to be trans-

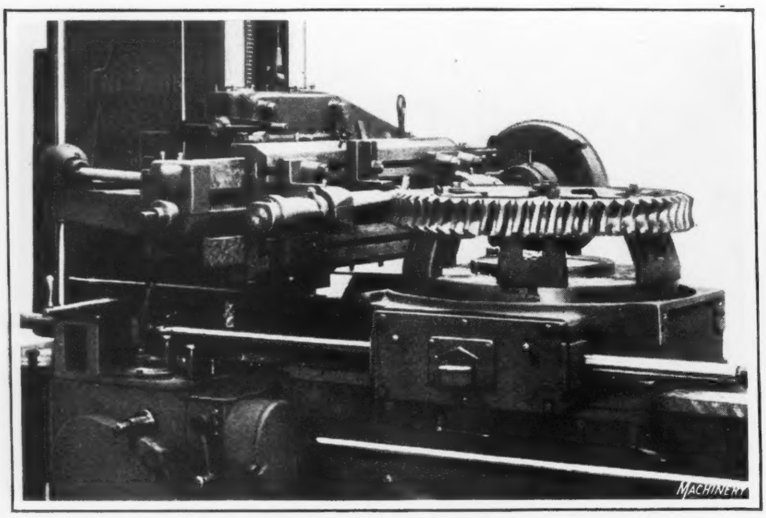


Fig. 6. Another Example of Worm-gear Cutting by Means of a Fly Cutter

mitted because worm-gearing has larger bearing surfaces and a greater power transmitting capacity for gearing of the same ratio and size.

In some cases when worm-gears for multiple-threaded worms are to be cut, it may not be economical to use a multiple fly cutter, because the number of worm-gears to be cut is not large enough to warrant the making of more than one cutter. For instance, if a single worm-gear intended for a double-threaded worm, is to be cut, a single fly cutter would be used ordinarily instead of a double fly cutter. However, if five or six of these worm-gears were needed, it might be advisable to use two fly cutters, because then the cutting time would be reduced one-half.

When more than one cutter is used, it is essential to have each cutter of the correct shape and accurately located in the bar or holder. When there are two or more cutters, all are usually located in a plane perpendicular to the axis of the cutter-bar. Worm-gears for double-threaded worms may also be cut by using two cutters located on the same side of the bar like adjacent teeth on a hob. This is done sometimes to facilitate locating the two cutters accurately, but there is the disadvantage of having both cutters working at the same time, which tends to cause excessive deflection of the cutter-bar. For ordinary pitches, two cutters are usually held by inserting them in a hole passing through the center of the bar, and each cutter is inclined so that the cutting face will be at right angles to the sides of the worm-gear teeth. If there are several cutters, a head arranged for holding them in the proper position is mounted on the cutter-bar. These multiple fly-cutter heads are similar to the section of a hob, as far as the shape of the cutting edges is concerned.

The machine is geared so that the work and cutter-bar run together just as though the worm-gear were in mesh with a worm, or, in other words, according to the ratio of the worm-gearing. If the number of teeth in a worm-gear is a prime number, the use of more than one cutter will result in a "hunting tooth" action between the cutters and worm-gear. Assume, for example, that the worm-gear is for a double-threaded worm, and that it has an even number of teeth; then a given cutter will cut every other tooth space and it will continue to pass through the same tooth spaces. The intervening spaces will be finished by the other cutter. Now, if the number of teeth is prime, a given cutter will cut every other tooth space as before, but it will not continue to operate in these same spaces each time the gear revolves. The result will be that each cutter will only pass through the same tooth spaces every other revolution, in this particular instance.

This progressive action is obtained not only when cutting worm-gears having prime numbers of teeth, but also when there are odd numbers not divisible by the number of fly cutters used. For instance, if a 21-tooth gear for a double-threaded worm were cut with a double fly cutter, the spaces cut by cutter No. 1 during the first revolution of the gear blank would be cut by cutter No. 2 during the second revolution; during the third revolution the cutters would again be in step with the spaces cut during the first revolution. On the other hand, if a 21-tooth gear were cut for a triple-threaded worm and three fly cutters used, these cutters would always keep in step with their respective tooth spaces since 21 is divisible by 3. If a 21-tooth gear for a quadruple-threaded worm were cut by using four equally spaced fly cutters, then each cutter would pass through the same series of tooth spaces after every fourth revolution. The hunting tooth or progressive action obtained as described is desirable in so far as it tends to equalize any inequalities that may exist in the different cutters, thus insuring the formation of more uniform teeth.

Application of Tapered Hobs to Worm-gear Cutting

When worm-gears of a good grade are required on a quantity basis, the tapered hob method is recommended. A Gould & Eberhardt automatic gear-hobbing machine having a cross-feed attachment for the cutter-head is shown in Fig. 7 cutting a bronze worm-gear by means of a tapered hob. This worm-gear has 32 teeth of 5 diametral pitch, and it is to mesh with a five-threaded worm. The total cutting time is one hour and fifteen minutes.

Another example illustrating the application of tapered hobs to worm-gear cutting is shown by the detailed view, Fig. 8. The Gould & Eberhardt machine used for this operation is designed especially for generating worm-gears. This machine may be used either with tapered hobs which are fed tangentially or with straight hobs having a radial feeding movement.

The cutter-spindle is carried by a heavy slide, which is adjustable along the bed to suit the diameter of the worm-gear. This slide also receives the feeding movement when using straight hobs and an automatic stop in conjunction with a graduated dial enables the operator to set the mechanism to stop at any predetermined point. When either a tapered hob or a fly cutter is used, this slide is set to give the proper tooth depth, and is then securely bolted to the base of the machine to obtain a rigid support as the cutting tool feeds tangentially across the blank. A differen-

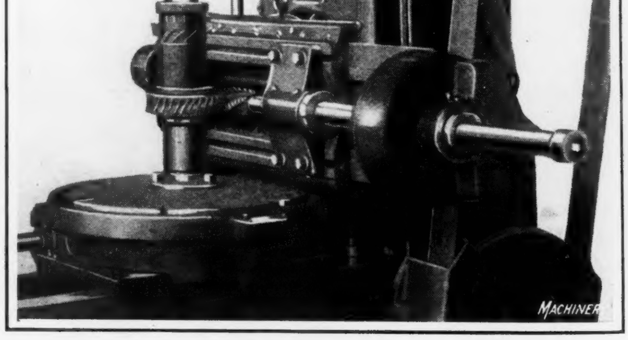


Fig. 7. Gear-hobbing Machine with Cross-feeding Attachment for cutting Worm-gears by the Taper-hob Method

tial mechanism is provided on this machine. One advantage of such a mechanism is that it enables the operator to take a second cut for finishing without "losing the lead." Moreover, the differential makes it possible to change the feed without changing the lead gears. As this differential is not required when a straight hob is used, provision is made for locking it.

The worm-gear generator shown in Fig. 9 is cutting a bronze worm-gear for a truck drive. This is another example of the taper-hob method. The cutting time for this gear is fifteen minutes. The generator used is made by the Lees-Bradner Co., Cleveland, Ohio, and is applicable either to the taper-hob or fly-cutter methods, as well as to the use of straight hobs and a radial in-feed. The taper hob is multiple-threaded, and differs from most taper hobs in that the teeth have very little relief at the large end; in fact, there is practically no relief, so the finishing end of the hob gives a certain amount of burnishing action. Moreover, sharpening the hob does not reduce the diameter appreciably nor change the helix angle, as in the case of a hob having considerable relief.

The main pulley shaft of this machine drives an auxiliary shaft, from which, by change-gears, the work-table worm is driven at a speed depending upon the ratio of the hob and worm-gear to be cut. The cutting speed of the hob, or the number of revolutions per minute, is also controlled by change-gears independently of the number of teeth to be cut, and in accordance with the hob diameter and the kind of material to be cut. The hob-spindle is driven through worm-gearing from the same auxiliary shaft that drives the work-table. The worm-shaft for the work-table drive connects with a differential controlled by change-gears to give the work-table an independent rotary motion to suit the tangential feeding movement of the hob, so that the work and hob rotate in unison regardless of the rate of feed. These change-gears are selected according to charts furnished with the machine.

The axial or tangential feeding movement is controlled by quick change-gears, giving twenty-two different rates of feed, and the arrangement is such that the work may be fed toward the hob to a given depth, and then the axial feeding movement may be started for finishing the teeth. The hob-spindle and arbor support are carried by adjustable bearings on a slide which is traversed in the main column by a screw and adjustable bronze nut. This movement is disengaged automatically at any predetermined point by an adjustable collar and trip-lever. When the hob is feeding axially across the gear blank, the work-table should be clamped to the bed by the binder handles provided on each side. An index on the machine may be used to locate the work in a rotary direction to suit the hob teeth when "catching the lead," as in recutting. This index is also used when a gear intended for a multiple-threaded worm is cut with a fly tool.

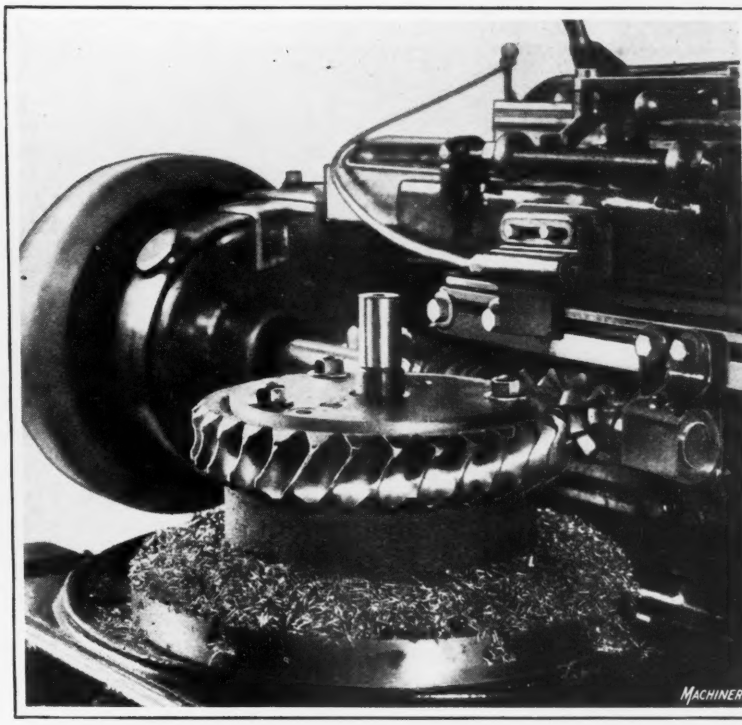


Fig. 9. Another Example illustrating Application of the Taper-hob Method

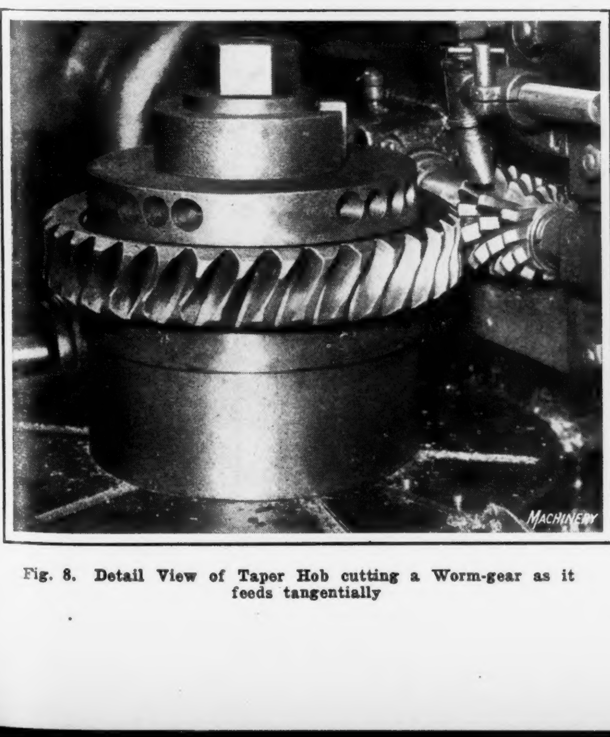


Fig. 8. Detail View of Taper Hob cutting a Worm-gear as it feeds tangentially

The handwheel for adjusting the table along the bed has an adjustable dial graduated to thousandths, and the radial in-feed may be disengaged automatically by a stop on the rim of this micrometer handwheel. A scale on the bed and a pointer on the work-slide may be used for checking the center distance between the axes of the hob and work.

Avoiding Under-cutting on Small Worm-gears

The under-cutting of the teeth of small pinions that occurs under certain conditions has already been referred to in connection with spur gears. The teeth of small worm-gears will also be under-cut, provided a wheel blank of standard size is cut in the usual manner with a 29-degree hob. In the case of spur gears there is only slight interference when a 12-tooth pinion of 14½ degrees pressure angle is in mesh with another 12-tooth pinion, but pronounced interference occurs if one of these pinions is run in mesh with a large gear, and maximum interference takes place when the pinion is engaged with an unmodified involute rack. Now, since the worm that engages a worm-gear is similar to a rack as regards sectional shape, interference or under-cutting occurs when the worm-gear has less than 30 teeth, assuming that a 29-degree worm is used.

One way to avoid this under-cutting is to enlarge the worm-gear blank, as is done frequently when making small spur pinions. The following Brown & Sharpe formula gives the throat diameter of an enlarged worm-gear blank. In this formula, O = throat diameter; D = pitch diameter; and S = addendum.

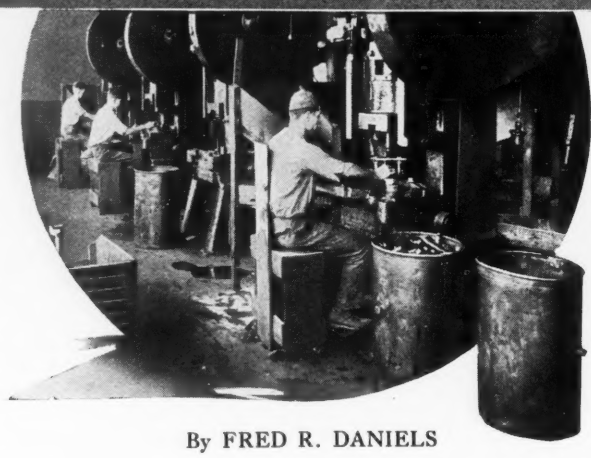
$$O = \cos^2 14\tfrac{1}{2} \text{ degrees } D + 4S$$

If the same center distance is to be maintained, the worm diameter is reduced as much as the throat diameter is increased. Another method of avoiding under-cutting is to increase the angle of the worm thread. The following formula in which N equals the number of teeth in the worm-gear is used for determining this increased angle:

$$\text{Cos } 1/2 \text{ worm thread angle} = \sqrt{1 - 2 \div N}$$

This change would involve making either a hob or a fly cutter of corresponding angle.

Practice of a Pressed Steel Plant



Sheet-metal Drawing Performed by Dies of Unusual Design

Methods Employed by the New England Pressed Steel Co.

By FRED R. DANIELS

IN any collection of sheet-metal drawing work, the examples shown in this article would doubtless be classified as unusual. They include a broom-holder shell, involving very unusual tooling equipment, and a muffler housing for motorcycles, produced by dies of interesting design. The practice described is that followed in the plant of the New England Pressed Steel Co. at Natick, Mass.

The pressed-steel broom-holder shown in Fig. 1 is used on a new type of broom which has recently been placed on the market. The making of this piece involves some rather unique press work. The shells are made from a hot-rolled and pickled sheet steel, especially intended for deep drawing operations, which is produced by the Allegheny Steel Co. An elliptical blank having a major diameter of 11 inches and a minor diameter of 10¼ inches is used; the thickness of stock is 0.042 inch.

Drawing Operations on a Sheet-steel Broom-holder

The broom corn used in this type of broom is arranged in four bundles, each fastened together with the ends cut square so as to rest evenly against a thrust plate which is assembled within the broom-holder. The thrust plate is located so that the end of the wooden handle, which fits in the ⅞-inch hole in the rounded end of the shell, may extend through about 1½ inches, and be gripped by spurs projecting from the under side of the thrust plate, where it is fastened by a wood screw. This construction furnishes a sufficiently rigid backing for the broom corn. The front of the shell is cut out as shown, so that the bundles of straw may be replaced or altered in position. The bundles are prevented from falling out by a cover which may be slid snugly into place over the opening, where it is secured by a lug which engages the ⅛-inch square hole in the holder. As a further support for the broom, a tapered ferrule or sleeve is slipped over the end of the handle which extends into the shell. The operations on this ferrule and on the thrust plate and cover are of minor importance, and will not be dealt with in this article.

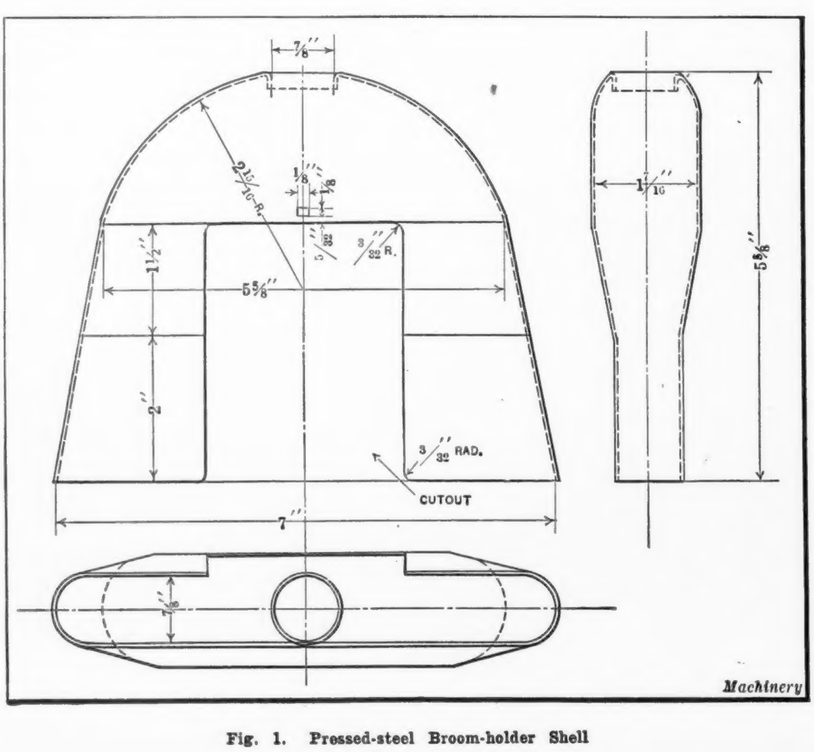


Fig. 1. Pressed-steel Broom-holder Shell

The evolution of the broom-holder, step by step, is shown in Fig. 2, and this illustration also gives the important dimensions on each shell. The stock is first blanked to an elliptical shape and drawn to the dimensions shown for the first operation, after which two redrawing operations are performed, which bring the shell to the size and shape indicated for Operation 3. For the average quality of stock, it is necessary to anneal the shell after the second operation and each succeeding alternate operation in which a reduction takes place. The inequalities in a consignment of sheet steel, no matter what the specifications may be, are often such that it is necessary to anneal even oftener than this, on account of the impossibility of making the required reduction without fracturing the stock. On the other hand, it sometimes happens that more than two reductions can occur before it becomes necessary to anneal.

Necking and Final Drawing Operations

The straight reductions are followed by two necking operations, which are in reality reducing operations in which the maximum reduction permissible is obtained. It is not practicable to reduce the shell on its complete depth to the dimensions which it has after Operation 5, because the stock will not stand such a reduction. These five operations are regularly performed on a Toledo No. 164½ toggle drawing press, it being necessary to have about a 13-inch stroke of ram. This press, with the dies used in Operation 4, is illustrated in Fig. 3, which also shows two shells before and after necking.

The final drawing operation, or tapering, produces the final shape shown in Fig. 2, the work being performed on a No. 56 Toledo back-geared press having a 13-inch stroke. This operation is illustrated in Fig. 4; here a shell before and after being tapered is shown lying on the bolster plate of the press. The seventh operation—trimming the flange—is done on a 6-inch stroke Consolidated

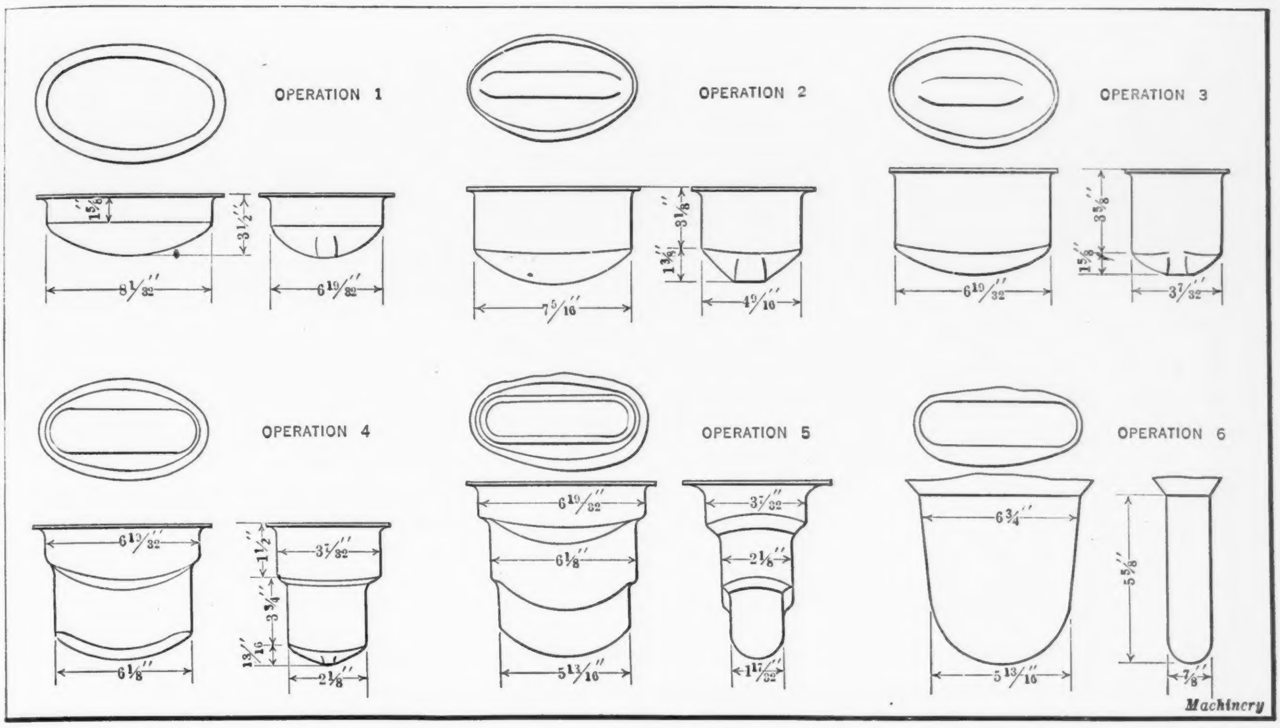


Fig. 2. Graphic Representation of the Various Drawing Operations Necessary to produce the Broom-holder Shell

press equipped with suitable trimming dies. The eighth and ninth operations are piercing the handle hole 9/16 inch in diameter, and turning in the neck to form a ⅞-inch diameter bearing for the broom handle. (See Fig. 1.) These two operations are performed on a No. 47 Consolidated back-geared press with a 6-inch stroke.

Dies for Flattening Shell and Cutting out Cover Opening

In the next two operations the shell is flattened to the final shape shown in Fig. 1, and the square lock hole and cover opening are pierced. For these two operations, special dies of more than ordinary interest are employed, as shown in Figs. 5 and 8, respectively. The die used in the flattening operation and the condition of the work after flattening are shown in Fig. 5. The faces of the lower and upper die members *A* and *B* are shaped to produce the desired flat and to meet on the horizontal center line of the shell.

The most unique feature of the die is the expanding unit which is shown lying against the lower die. This unit, when in use, rides on posts *C* which extend through two holes in the expanding member so that the floating members *D* (of which there are two) will extend to the front, in the reverse position of that shown. The floating members are expanded by a wedge *E*, which is advanced or receded by means of the handle. The shell is slipped over the expanding unit until it abuts against stops *F*, after which the handle is pulled forward to advance the wedge *E* between the floating members. This results in gripping the shell from the inside and holding it in the correct position. The wedge is connected to strip *G* by long connecting-rods, and the floating members are tied together in tension by two coil springs.

The vertical movement of the floating members is made possible by special headed pin keys which operate in the T- and L-slots shown. When the upper die member *B* contacts with the shell on the downward stroke of the press ram, it forces the expanding unit down on posts *C* against the pressure of four coil springs until the shell is sufficiently flattened. During this movement, post *H* on the upper member bears against the expanding unit between the two holes through which the lower posts *C* extend, thus assisting in

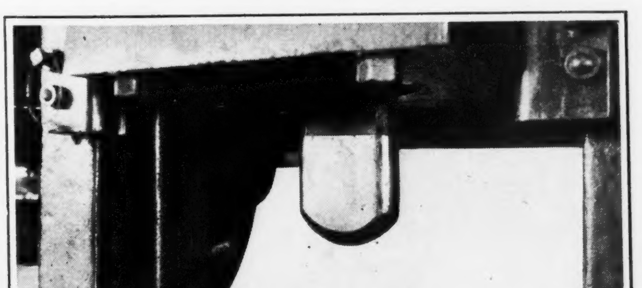


Fig. 3. The First Necking Operation, showing the Dies and the Work

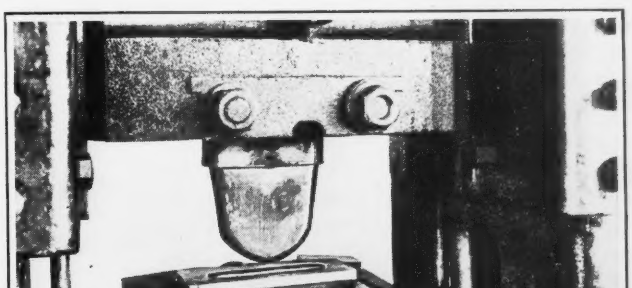


Fig. 4. Dies used for tapering or rounding the Ends of the Shell

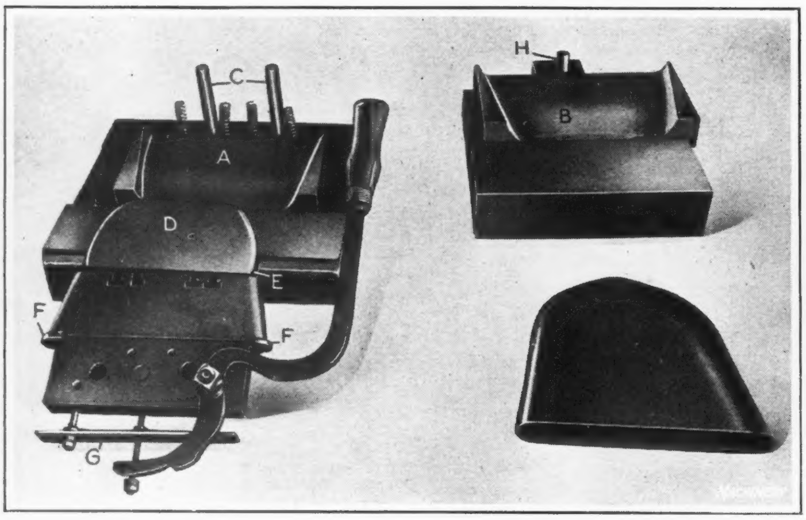


Fig. 5. Specially Constructed Flattening Dies of the Expanding Type

the depression of the expanding unit and eliminating the possibility of this unit sagging from its overhanging weight and binding on the posts. The flattened shell can be quickly released after the press ram has ascended, by simply pushing back the handle, which withdraws the expanding wedge and permits the two coil springs that hold the floating members together to contract.

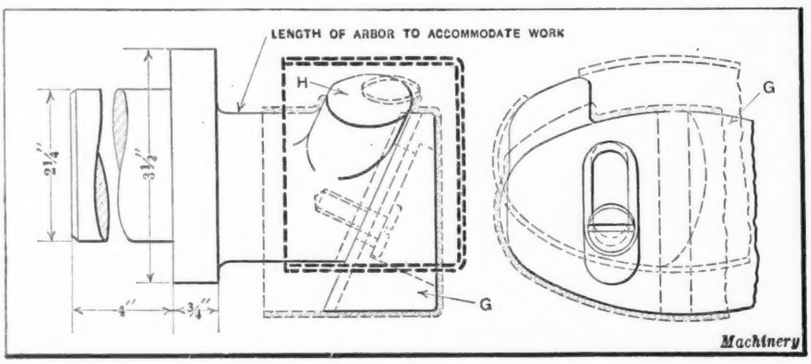


Fig. 6. Arbor over which Flange surrounding Side Hole in Muffler Housing is drawn

The cutting out die, Fig. 8, is so designed that both the operations of piercing the small lock hole and cutting out the large square opening can be accomplished at the same time. The square punch *A* is made removable, so that it can be readily replaced. It will be realized that the amount of wear and the likelihood of breakage in using such a slender punch is considerable. With the upper die member constructed in this manner, the two operations can be successfully performed simultaneously. The work fits over die *B*, and is located transversely by the two stops shown on the side of the die. The scrap is permitted to drop through the die, and plate *C* strips the punch on the upward stroke of the ram. A shell, as it appears after this operation, is shown at the right of the die.

In describing the manufacture of the muffler housing illustrated in Fig. 7, only those operations that involve special equipment will be considered. This shell, which is the muffler front-head used on a well-known motorcycle, is drawn to shape in three straight drawing operations and one necking operation. The shell is made of No. 15 gage pressed steel, 0.070 inch thick. It was found necessary in the reduction process, to anneal the stock after each operation. The necking operation is followed by a finish-drawing operation to size the shell, after which the uneven edge produced in the reduction processes is squared off. After squaring the end, the side hole *A*, and the end hole *B* are punched. The shell then has the appearance shown at *A* in Fig. 9.

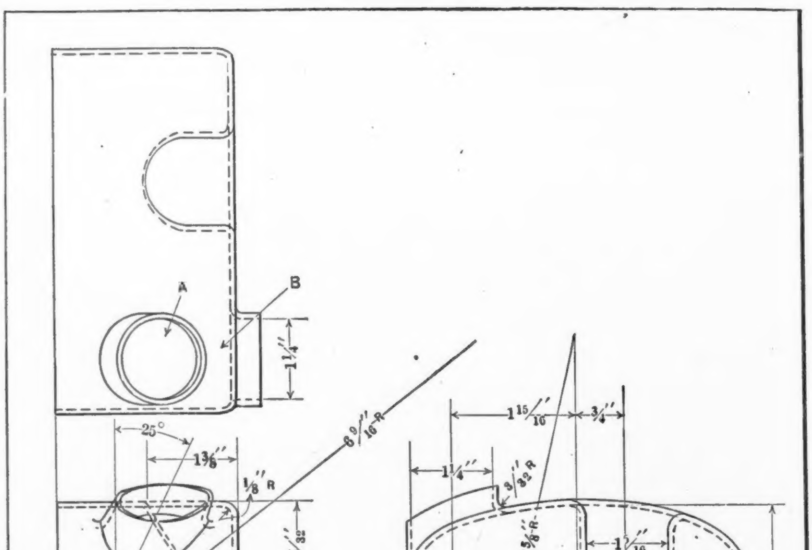


Fig. 7. Front Head of a Motorcycle Muffler Housing

The punch and die used to pierce the side hole are shown in the upper right-hand corner of Fig. 10. The die is an arbor, held in a block carrying a steel bushing *A* and an end plate *B*. Plate *B* is provided with suitable clearance to accommodate the depression *C* in the shell, and thus aid in locating it on the arbor during the piercing operation. Incidentally, it may be mentioned that this depression in the shell is gradually formed in the series of drawing operations. A No. 4 Consolidated short-stroke press is employed in punching this hole. The punch is of simple construction, and is shown at *D*.

By inspecting the shell shown in this illustration, as well as in the detail view, Fig. 7, it will be seen that the drawing up of the flange around this hole presents a condition which involves unusual drawing work. Not only is the hole located unsymmetrically on a curved surface, but also the flange is at a 25-degree angle with the vertical. The abrupt change in the direction of the steel fibers produced by this operation makes it necessary to anneal the shell with great care before this step, and sometimes two annealings are required to prevent fracture, particularly at the acute angle which occurs at about point *E*, Fig. 10.

Side- and End-hole Drawing Dies

The arbor employed for drawing up the stock around the side hole is illustrated at the left in Fig. 10; this is substituted in the die-block for the arbor used in the hole-punching operation. The arbor carries a specially formed sliding shoe *G* which rides on the end of the arbor

at an angle with the horizontal equal to the angularity of the flange to be drawn. The construction of the arbor will be understood by reference to Fig. 6; the position of the work when first slipped into place is indicated in dotted outline, and the position after the flange has been drawn by broken sectional lines. The shoe *G* is guided in its angular movement by a key in the end of the arbor, and it is loosely held to the arbor by a flat-headed screw. The shoe has an elongated screw slot to allow for its movement.

To locate the shell on the arbor preparatory to drawing, the shoe *G* is slid upward by hand to permit the shell to clear horn *H*, at which position the lower side of the shoe will coincide with the corresponding portion of the arbor. When the ram descends, carrying the specially formed face punch shown in Fig. 10, the shell is carried down with the shoe until the stock is drawn around the horn *H*, as shown in Fig. 6. At this point, the downward movement of the shoe is limited by the length of the elongated slot. The shell may be readily removed by simply raising it until it clears the horn. It will be evident that the face of the punch is shaped to conform to that part of the shell on which it is to seat, and also that it has a hole of suitable size to accommodate the drawn flange, being nicely rounded at the edge to produce the filleted surface which joins the flange to the shell proper. The press used for drawing up the side-hole flange is a Waterbury-Farrel, 10-inch stroke.

The specially designed dies required for drawing up the flange for the end hole *B*, Fig. 7, are shown at the left of Fig. 9. The shell before the flange is drawn is shown at *A* in this illustration. This die is set at a 15-degree angle on the bolster plate of the press so as to position the lower punch *B* vertically. This punch extends through the upper die-plate at an angle of 15 degrees. The upper plate which carries the die is spring-supported, and has four dowel-pins to guide it when depressed by the descent of the punch. This plate then acts as a stripper,

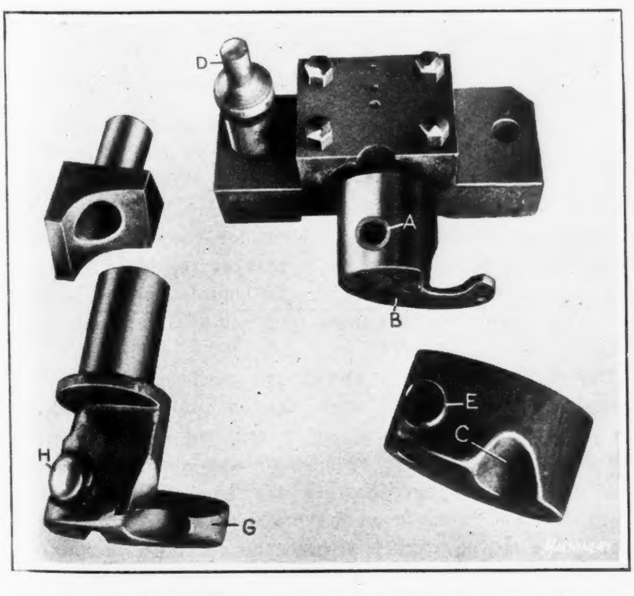


Fig. 10. Punches and Dies used to punch the Side Hole and to draw up the Flange which surrounds this Hole

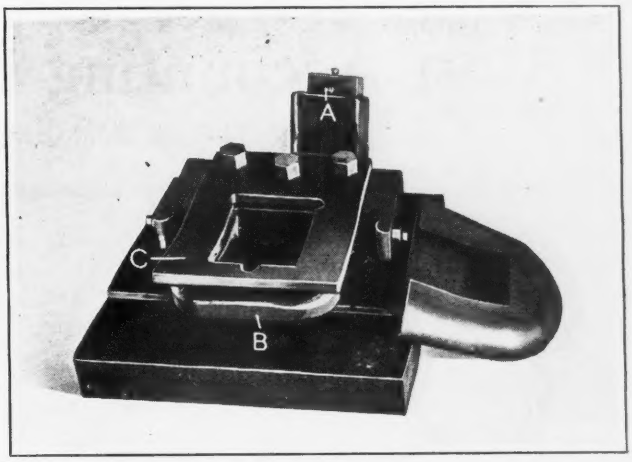


Fig. 8. Die and Punch used to cut out a Section in one Wall of the Broom-holder Shell and pierce a Small Square Locking Hole

lifting the finished shell from its seat on the die as soon as the ram ascends. A movement of about 1¼ inches is obtainable. It will be evident that the face of the punch is angular to agree with the 15-degree angle at which the die is set on the machine. For drawing up this end hole, a 10-inch stroke Waterbury-Farrel press is used, the same as in the drawing up operation on the side hole.

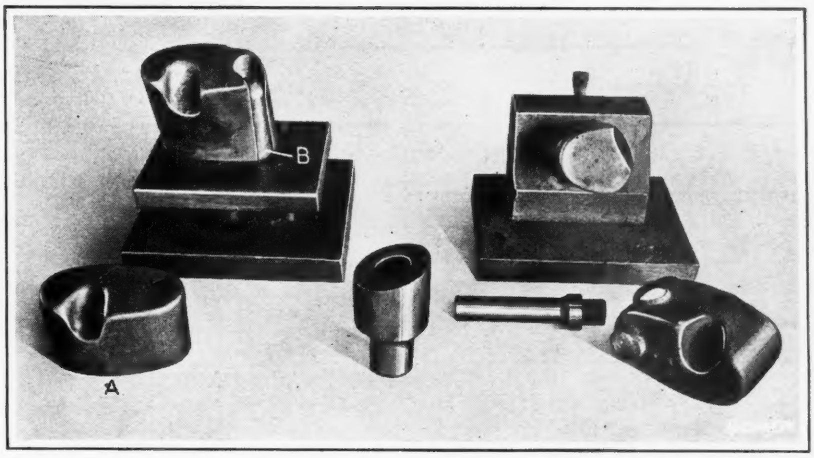


Fig. 9. Tools used to draw the Flange surrounding the End Hole in the Muffler Housing and to size the Side Hole

The finished shell is shown at the right in this illustration; also the die and plain punch used in sizing the side hole. It will be evident that in drawing this flange at the angle required it would be almost impossible to maintain a round hole. Hence a final sizing operation is employed, using the simple equipment shown at the right of the illustration, as previously mentioned.

* * *

SPECIFICATIONS FOR TOOL STEEL

Carbon tool steel specifications have been tentatively approved by a committee of the American Society for Testing Materials. Copies of these specifications, which cover six classes of carbon tool steel as determined by chemical composition, may be obtained from the American Society for Testing Materials, 1315 Spruce St., Philadelphia, Pa. The specifications cover the purposes for which the different kinds of tool steel are most frequently used; the method of manufacture, whether by the crucible or the electric furnace method; annealing; chemical composition; methods of analysis; tolerances on dimensions; finish; marking; and methods of inspection and rejection.

From a practical point of view it does not seem that these specifications fully cover the needs of the industry. As has been pointed out in several articles in MACHINERY during the past year, chemical composition alone does not insure good tool steel (any more than good ingredients alone in a cake insure good cake). There are other factors to be considered, and any satisfactory specifications for carbon tool steel should include actual service tests. No association would be better fitted to sponsor a standardization of the service tests that would determine the quality of tool steels than the American Society for Testing Materials.

Cost Accounting in the Jobbing Shop

By LUDWIG B. PROSNITZ, Certified Public Accountant

NEGLECT in keeping records of labor, material, and overhead costs in jobbing machine and tool shops has frequently resulted in the failure of a business. The owners may have been well qualified mechanically to run it, but they were ignorant of the importance of an efficient cost accounting system as a factor in the success of the enterprise. The present article outlines a simple system of keeping cost records which is especially adaptable to the jobbing shop. It is correlated to the bookkeeping end of the business only to a limited extent, because for the average shop of this kind the cost of conducting a system thoroughly interwoven with the financial records would be prohibitive and of no particular value.

Handling Customers' Orders

Only written orders should be accepted; this is not adhered to in some machine and tool shops, as there is a tendency not to bother the customer too much. Customers with experimental work in particular, have a disinclination to issue specific instructions in writing, and many jobbing concerns that have been negligent with regard to requirements in this respect have learned by bitter experience the truth of the old adage, "An ounce of prevention is worth a pound of cure." Orders should contain full particulars concerning the work to be done and a concrete statement as to the ultimate cost. It is customary to undertake jobs at a flat contract price, at a certain rate per hour, or at a stated percentage above cost. Which ever way is followed, the terms of payment should be stipulated at the outset. Some orders are likely to take an indefinite period for completion, and if the shop has insufficient capital to keep going without assistance from those customers whose work is in process, advance payments on account should be provided for in the contracts.

When an order is received, in the system to be discussed, it is entered in the customers' order book in numerical sequence. This record is used only to obviate the necessity of frequent reference to cost sheets which will be described later. The order number of the shop is placed on the customer's order, and the customer's order number and other pertinent data are inserted in the customer's order book. A rubber stamp "Billed" is prominently displayed on each order in this book when the job is completed and charged to the customer. It is urgent that this book be examined at regular intervals, and wherever the "Billed" stamp does not appear, some explanation should be made; a cost sheet may have been lost from the file or a shipment may have been made without notifying the office.

COST SHEET

NO. 2748 DATE Nov. 2, 1922 CUST. NO. 471 A

NAME Smith & Co. ADDRESS 200 South St. N.Y.

JOB Three Dies as per B/P 20818

RATE	EMPLOYE	November 2	5	8	9	12	13	HOURS	AMOUNT
0.60	John Doe	8			4		8	20	12 00
0.70	Richard Roe		6			2	6	14	9 80
0.80	James Lee			10		1	4	15	12 00
								49	33 80
		Overhead @ .60¢ per hour							29 40
		Total Labor							63 20
		Material							94 92
		Total							158 12

SHOP ORDER

NO. 2748

JOB Three Dies as per B/P 20818

DATE TAKEN 11/2/22

PROMISED 11/15/22

COMPLETED 11/13/22

EMPLOYES Nos 8-41-73

REMARKS

Machinery

Fig. 1. Form on which Labor Costs for a Job may be itemized, and Shop Order Stub which is torn off and given to the Foreman

Cost Sheets and Shop Orders

Cost sheets and shop orders are made up from the customers' order book, both being combined in a single form as may be seen by reference to Fig. 1. The sheet is perforated so that the shop order can be conveniently detached. The face of the cost sheet provides for recording and summarizing all labor costs, while the reverse side, shown in Fig. 2, is intended for use in the compilation of material costs and any other expenses applicable to that particular order.

The forms in Figs. 1 and 2 are filled out to show the manner of recording all shop costs in connection with job No. 2748 for Smith & Co. It is assumed that sixty cents per hour for each hour of labor is the charge determined upon to cover overhead costs and profit, and that a charge of 10 per cent is made on the material costs, etc., to cover handling costs in connection with the purchase of materials and other expenses. The labor cost data are gathered from time slips which will be explained later.

The shop order is given to the foreman, together with all the blueprints and sketches marked with the job number, who figures out the material required for the entire order, and requisitions this material from the stock-room. The foreman also decides which men shall be given the job and marks the shop order stub accordingly. By estimating all the material requirements in advance, the number of requisitions is reduced to a minimum, with a consequent saving. The blueprints are usually needed by those working on the order; however, as the shop order stub contains information required by the foreman, it is retained by him.

It cannot be too strongly emphasized that work in process should be inspected at frequent and regular intervals, and the importance of having an efficient, conscientious foreman who will be responsible for such inspection can hardly be overestimated. Failure to inspect products thoroughly from time to time and just before shipment, may result in losses aggregating thousands of dollars.

NO. 2748

MATERIAL AND EXPENSES

DATE 1922		NC.	PARTICULARS	AMOUNT	
Nov.	10	P.C. 7	Freight		20
	11	M. 9	Tool Steel	34	87
	12	Inv.	Brown Steel Co.	41	39
	13	C.B. 11	Hardware	9	83
				86	29
			10 % charge	8	63
				94	92

CONTRACT Cost plus 60 cts & 10% SHIP. REC. NO. 2080

PROMISED 11/15/22 BILL NO. 5819

COMPLETED 11/13/22

REMARKS

Machinery

Fig. 2. Reverse Side of the Form in Fig. 1 which is used to record Material and Other Expenses except Labor

Upon the completion of an order, a notation to that effect is made on the shop order stub, and it is then turned into the office for billing purposes. In the "No." column of Fig. 2, P. C. 7 refers to a petty cash slip number, M. 9 to a material requisition number, "Inv." to an invoice of steel that was used directly on the order and never entered the stock-room, and C. B. 11 to a special payment made by a check listed on page 11 of the cash book.

It will be noticed that this side of the cost sheet has provision for marking the terms of the contract and other pertinent features of the order. It may be asked why all material does not enter the stock-room so as to eliminate cash book reference, as it would seem better practice to enter invoices for all items through the purchase journal. Suffice it to say that strict accounting is not always practicable in machine shops, and it is frequently advisable to let down the bars in the interest of expediency.

Operations paid for on a piece-work basis may be conveniently recorded on the sheet illustrated in Fig. 3, the headings of which are substantially the same as on the regular cost sheet. The check (√) column is used to indicate the transfer of the wages earned to the employe's clock card for payroll computation. When manufacturing parts on a quantity production basis and several operations such as turning, assembling, etc., are necessary, a separate sheet is desirable for each operation. The reverse side of the piece-work cost sheet is the same as that shown in Fig. 2.

Under no circumstances should the clerk allow a cost sheet to be taken from the binder, because of the difficulties which would occur if one should become lost. The cost sheets should be examined weekly, and a production report compiled to show the progress of orders. With such reports accessible, an executive can check up and facilitate the progress of work. A form that has been used to advantage for this purpose is shown in Fig. 4.

Keeping Time- and Piece-work Labor Costs

All employes should punch clock cards morning, noon, and evening and fill out time slips daily, giving an account of their work on the previous day. In order to have these slips filled out with neatness and accuracy it is best, especially in a large shop, to entrust the clerical details to either a factory or an office clerk. After the slips are collected, they should be checked with the clock cards. The clerk making this check should ascertain that every employe who has punched a clock card has also filled out a time slip, and that the hours on the time slips correspond with the hours credited on the clock cards.

If an employe is absent, his time slip should be filled out for him, as no credit can be inserted on the clock card until a slip is received, and it often happens that the payroll must be computed before the employe returns. This would necessitate the listing of delinquents and such a list

PIECE-WORK COST SHEET

NO. DATE CUST. NO.

NAME ADDRESS

JOB

OPERATION

DATE		CLOCK NO.	EMPLOYE	√	HOURS	QUANTITY	RATE	AMOUNT		REMARKS

Machinery

Fig. 3. Cost Sheet used instead of that shown in Fig. 1, when Employes are paid on a Piece-work Basis

PRODUCTION RECORD MONTH OF ______________ 19________

JOB NO.	CUSTOMER	JOB		SALES PRICE	DELIVERY DUE	PROGRESS OF JOB, WEEK ENDING ________					REMARKS
		QUANTITY	DESCRIP.								
											Machinery

Fig. 4. Form which should be filled out monthly so that an Executive may readily check the Progress of Orders through the Shop

would have to be followed up persistently. In order to account properly for all labor, it is absolutely essential that a time slip be obtained for every hour of labor that eventually finds its way to the payroll sheets.

Payment on the piece-work basis is especially desirable when the quantity production of uniform parts is undertaken. When this system of payment is followed, the piece-work hours should be separated from the regular time-work hours on the employes' clock cards. It is not usually the best practice to compute piece-work wages on the daily clock cards, because many employes do not want their earning capacity to be known nor is such publicity desirable from the viewpoint of the management. Reference may be made to the cost sheet for this purpose until the end of the week, when the wages may be marked on the clock cards, as they then remain in the office.

A convenient form for reporting both time- and piece-work production is presented in Fig. 5. The last three columns of this slip "Quantity," "Rate" and "Amount," are used only for piece-work. Before posting the time slips on the cost sheets, they should be countersigned by the foreman, who may refer to his shop order stubs for any information that he may desire. This check-up by the foreman serves to visualize in his mind the daily progress of the shop, and enhances the accuracy of the cost records. The time slips, when posted, should be filed according to the date and the clock number of each employe, for ready reference.

Payroll Computation and Distribution

Assuming a weekly payroll, at the end of the week the clock cards already have the hours accredited, and piece-work wages may then be compiled by reference to the customers' cost sheets. A person other than the one who inserted the original figures, should total them, mark the rates, and extend each card. The payroll clerk or bookkeeper in charge should then recheck the cards, after which they are ready for listing in the payroll book. The insertion of all other salaries not covered by the clock cards completes the payroll.

The time slips are entered against the customers' cost sheets, and other sheets which are headed "Unproductive Labor, Plant Order No.—" and similar general ledger divisions. In other words, all labor naturally will not apply to customer's orders. At the end of the month, the sum of labor costs charged to the latter sheets, plus foremen's, officers', office, salesmen's and other salaries not included in the cost sheet entries, are subtracted from the total payroll for the month, to give the charge applicable to "productive labor."

Should it be deemed desirable to subdivide productive labor into component departments, the most practical method would be to have a group of cost sheets known as "general ledger sheets," and distribute all time slips thereon prior to posting on the customers' cost sheets. The payroll should be charged on the books according to the last day of the week, thereby avoiding monthly accruals, which need only be considered on working sheets for the purpose of the financial statement. Thus, if the week ends on the first day of a given month, the entire payroll for that week will be charged against the new month.

The Stock-room

The stock-room should be centrally located so as to be readily accessible to the majority of employes. Material and tools should be conveniently assorted, and controlled by stock record cards kept in the office or the stock-room, or in both, as the circumstances may warrant. A monthly inventory can be obtained by pricing and listing the stock cards. Materials for current use should be requisitioned on forms.

Tools are usually placed under the control of the stock clerk as they constitute an expensive item and care must be taken to safeguard against their loss. Besides, the tools may be interchanged continually throughout the day by the employes in the course of their work, and it is necessary to keep track of the exact location of a particular tool. Various methods have been devised for this purpose, among which the tool check system has met with considerable favor. Under this system, each employe receives a certain number of checks on which his clock number is stamped, and when a tool is entrusted to his care, he gives the stock-room clerk one of these checks, which is placed on a hook adjacent to the location of the tool in question when it is in the stock-room. At the end of the day the stock clerk can readily ascertain the location of all tools. It is not unusual, unless extreme precautions are taken, to have tools damaged or lost. Monthly reports made by the stock clerk, specifying the cause or origin of damaged or lost tools, will tend to reduce such occurrences to the minimum.

Miscellaneous Bookkeeping Considerations

When purchase orders are issued, at least the copies should contain a reference to the purpose of the requisition, telling whether the material is for a job, stock, or equipment. Space should be provided on the form for answering that question, and if for a job, the job order number should be specified. Every invoice received should be marked to indicate the account to which it is to be charged before being entered in the purchase journal. If the charge is made to "Material Purchases," this should be indicated, and there should be an additional reference showing whether it is applicable to stock or directly to a customer's order. If the lat-

TIME SLIP DATE______________

NAME______________________ CLOCK NO.__________

JOB NO.	OPERATION	HOURS	QUANTITY	RATE	AMOUNT

FOREMAN Machinery

Fig. 5. Convenient Time Slip which is filled out daily

ter is the case, an entry should be made in a special "Job Number" column provided in the purchase journal, from which it may be posted on the cost sheet indicated by the order number.

Special outlays in connection with customers' orders are frequently required. These may be in the nature of petty cash, expenditures or check-book items and, on rare occasions, journal entries involve items affecting customers' orders. All books of original entry should be provided with a job number column, so that no item of cost applicable to a customer's order will be overlooked.

The overhead in a machine jobbing shop is best applied on a productive hour basis. Overhead expenses are more or less uniform from month to month and include the usual factory, selling, and administrative expenses, while the volume of work on hand has a tendency to fluctuate violently, and the labor turnover is high. For these reasons it is advisable to examine the overhead rate monthly. The total number of productive hours per month divided into the standard overhead expense for the month, plus a predetermined rate per hour for profit, will give the rate per hour to add to each order as it is billed, so as to cover overhead and profit. Assuming 5000 productive hours, an overhead expense of $2000, and a desired profit per hour of 10 cents, it would be necessary to add 50 cents per hour in billing all orders. The most satisfactory rate to apply is that determined by averaging the experience of several prior months, provided, of course, that no radical changes have occurred in conditions.

Parts for machines, miscellaneous equipment, etc., are frequently manufactured on the premises, either because they are needed immediately or because such a procedure is the most economical. Such orders should be handled similarly to customers' orders, and upon completion, a journal entry should be made, debiting the asset created and crediting "Productive Labor." Credit should be made to the latter account due to the fact that the payroll account is distributed monthly, regardless of plant orders in process. Charges involving the latter usually find their way into the productive labor account.

Problems such as depreciation of machinery, equipment, tools, dies, etc., are similar to those customary in other manufacturing establishments. In order to obtain monthly operating statements, it is best to adopt standard monthly rates of depreciation, so that the annual depreciation charges will be equitably distributed over the twelve months. Accounting requirements not dealt with in this article are similar to those encountered in other business enterprises.

It is universally understood that the best of systems cannot be dogmatically applied to all machine shops. Every organization has its own peculiar problems. We can, however, proceed on the fundamental proposition that a successful plant must be well regulated, and that a thorough accounting system is a necessary corollary thereto. We formulate general principles in order to establish our foundation, and then build our house according to the individual requirements.

* * *

COMBINING TWO ENGINE LATHES TO INCREASE SWING

Many machinists have had occasion to reverse the headstock of an engine lathe on its bed so that the faceplate would overhang the end in order to increase the swing. The accompanying illustrations show how this expedient was employed in combining two engine lathes to obtain the capacity required in machining an electric motor spider. The work constituted part of a course of training at the Chapman Technical High School, New London. In this case, a five hosepower motor was being built, the spider of which had a diameter of 25 inches. The largest lathe in the school would swing only 14 inches. However, by arranging two of the lathes as shown, it was possible to handle the work satisfactorily.

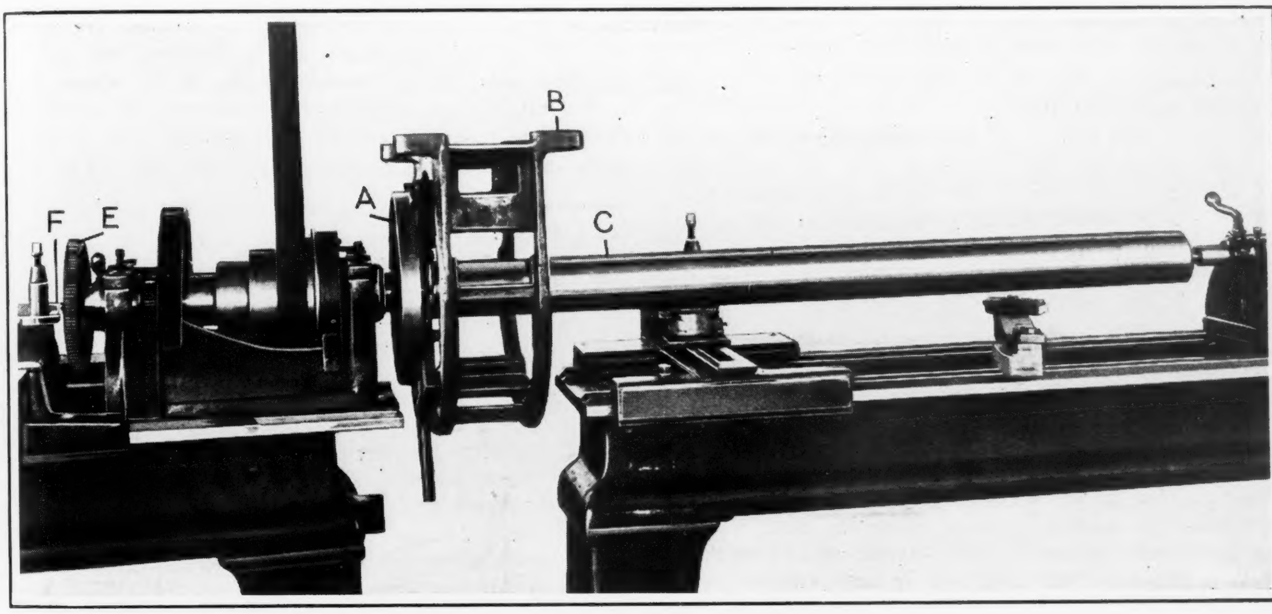


Fig. 1. Making Use of Two Combined Lathes to obtain Increased Swing

The headstock on the lathe shown at the left in Fig. 1 was turned around so that a faceplate *A* could be attached to hold the spider *B*. This allowed the spider to swing clear of the end of the lathe bed over the floor. However, this arrangement made it impossible to employ the toolpost and carriage of the lathe with the reversed headstock. The bed of this lathe was carefully leveled up, and the lathe to the right unfastened from the floor and brought up close to the first lathe, as shown. The toolpost of the second lathe was thus brought into position to be used in machining the spider.

It was necessary, of course, that the beds of the two lathes be in the same plane and in nearly perfect alignment. The over-arm cylinder *C* was taken from a universal milling machine and mounted on centers between the two lathes, one end being held by a center in the reversed head of the first lathe, and the other by a center in the reversed tailstock of the second lathe. Since the first lathe bed was level, it was only necessary to level the bed of the second lathe. The leveling of the second lathe bed was done in the manner described in the following:

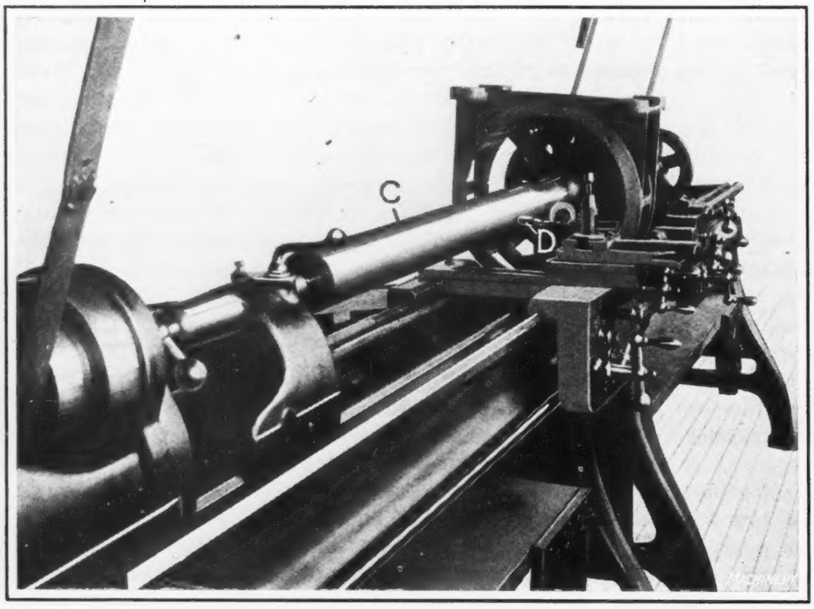


Fig. 2. Using Milling Machine Over-arm and Micrometer mounted in Toolpost to align Lathe Beds

A micrometer *D*, Fig. 2, was mounted in the toolpost of the second lathe, with the axis of the handle level with and pointed toward the axis of the cylinder *C*. By taking a reading when the handle was in contact with one end of the cylinder, and then moving the carriage to get a similar reading from the other end, the error in alignment was readily obtained. Many hours of labor were required to correct this error. The jar of the machinery was sufficient to make the testing unreliable, so that most of the work had to be done when the power was off. When the error in alignment had been reduced to one-quarter of a thousandth inch to the foot, the machining work was started.

The problem was to machine eight equally spaced slots in the inside of the spider. For this work, a heavy tool-holder was made from a piece of wrought iron 2 inches square, and clamped to the lathe carriage. At first the longitudinal power feed was used to plane or shape the slots, but the work progressed so slowly that the feed was thrown out and the carriage fed back and forth by hand, different members of the class taking turns at the work until it was completed. In order to make the spacing equal, a 120-tooth gear *E*, Fig. 1, was rigidly fastened to the spindle head and used as a graduating or indexing device. Every fifteenth hole was left open, and all the others were filled with beeswax. This gave eight equally spaced notches. A bar *F*, held in the toolpost, served as an indexing pin, so that when it was fitted into one of the open spaces, it held the spider in position while a slot was being cut. The work was indexed by withdrawing the bar, making an eighth revolution, and again pushing bar *F* into the open space. C. T. H. S.

* * *

TOOL-HOLDER FOR CUTTING IN BOTH DIRECTIONS

A tool-holder designed for cutting on both the forward and return strokes is shown in the accompanying illustrations. This holder may be used on either a planer or a shaper. It is the patented invention of Ivar Ericksen, shop foreman of the Stierlin Machine & Die Works, Chicago, Ill. In the illustrations, *A* is a roughing tool and *B* a finishing tool. On the forward stroke of the shaper ram, tool *A* takes a cut, while tool *B* rides over the work. On the return stroke of the ram, tool *A* rides over the work while tool *B* takes a second or finishing cut. Thus when the tool-holder has been fed all the way across the work from right to left, the surface of the casting or work will have been completely finished by a roughing and a finishing cut.

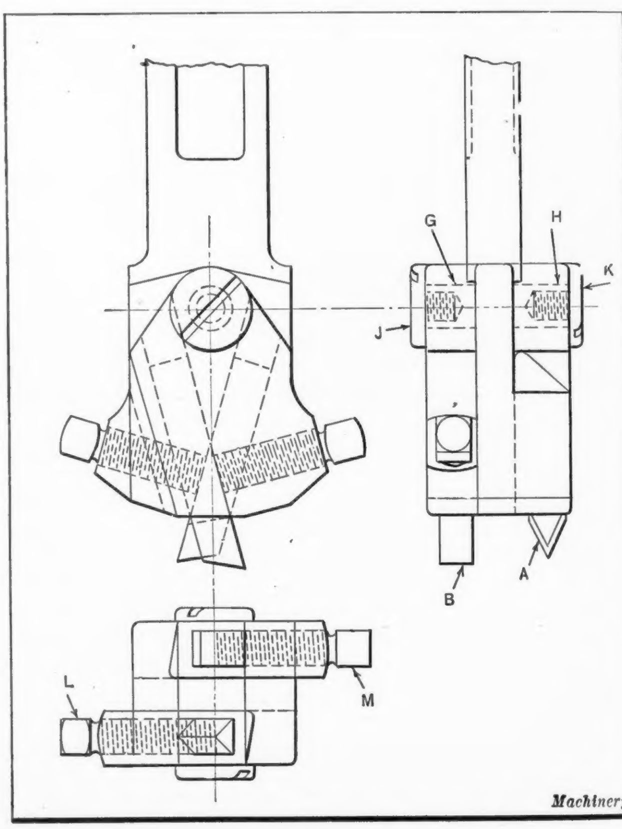


Fig. 2. Details of Tool-holder shown in Fig. 1

The tool consists essentially of a shank *D* and the two clappers *E* and *F*. These clappers are pivoted on hubs machined on the shank *D*, as indicated at *G* and *H*, Fig. 2, and are held on these hubs by screws *J* and *K*. The tools *A* and *B* are held in slots in the clappers by means of set-screws *L* and *M*. The shaper clapper is fastened down by means of a cap-screw *C*, as shown in Fig. 1, when this tool is in use.

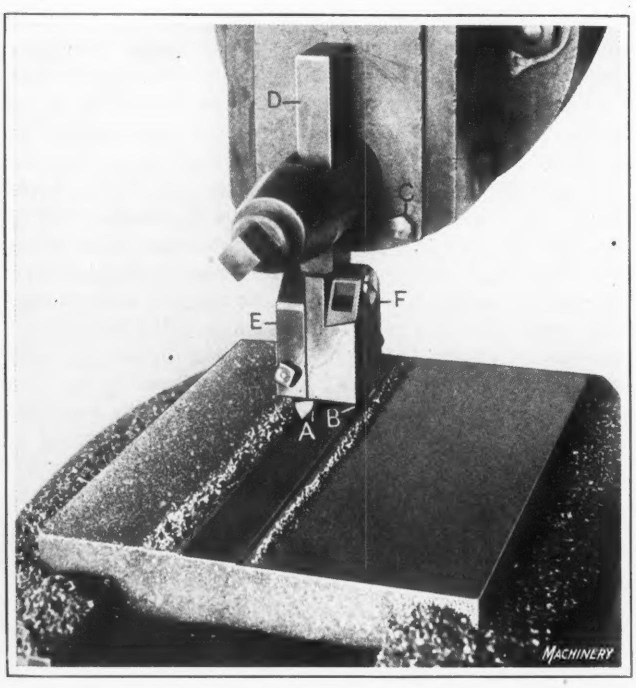


Fig. 1. Tool-holder equipped with Cutters designed to take Roughing Cut on Forward Stroke and Finishing Cut on Return Stroke

Designing Change-gears for Fixed Centers

By H. H. MANNING

THE practice of making the speed and feed changes of modern machine tools in geometrical progression is now almost universal. In designing production tools there seems to be an increasing tendency toward the use of the so-called "pick-off" type of change-gears, which consist of gears that are interchangeable on pins or shafts having a fixed center distance. The writer has found that the computations entering into the design of such gears are troublesome to many draftsmen and designers, and that the cut-and-try methods commonly employed generally consume considerable time. The tables and formulas here presented deal with the design of gear sets of this type, and should enable the gears required to be selected readily without resorting to cut-and-try methods.

TABLE 1. NUMBER OF GEARS REQUIRED IN GEAR TRAINS

Gear Trains Consisting of Two Gears									
Number of changes.....	2	3	4	5	6	7	8	9	10
Number of gears required	2	4	4	6	6	8	8	10	10
Gear Trains Consisting of Four Gears									
Number of changes.....	6	8	10	12	14	16	20	..	..
Number of gears required	8	6	12	8	16	10	12	..	..

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The first step in designing a gear set is to decide just what speeds or feeds are required, the number of changes, the ratio of progression, etc. Usually certain factors are known or assumed at the start, and the others must be calculated from them. These known or assumed factors and the factors that are to be found are in general included in one of the three following cases:

(1) When the known factors are the lowest speed, ratio of progression, and number of changes, and the unknown factors are the successive speeds.

(2) When the known factors are the lowest speed, the highest speed, and the number of changes, and the unknown factors are the ratio of progression, and the intermediate speeds.

(3) When the known factors are the lowest speed, highest speed, and ratio of progression, and the unknown factors are the number of changes and the intermediate speeds.

The solution of Case (1) is very simple, it being only necessary to complete the geometric series, which involves nothing but the process of multiplication. For instance, assuming that the lowest speed is 120 revolutions per minute and the ratio of progression 1.10, it is only necessary to multiply 120 by 1.10 to obtain the second speed. To obtain the third speed the result obtained for the second speed is multiplied by 1.10, and so on until the successive speeds for the whole number of changes has been obtained.

The first step in the solution of Case (2) is to find the ratio of progression. This is accomplished by the use of the following formula, found on Page 717 in MACHINERY'S HANDBOOK:

$$r = \sqrt[n-1]{\frac{t}{a}} \qquad (1)$$

in which

r = ratio of progression;
n = number of terms;
a = first term of progression; and
t = last term of progression.

After the ratio has been found by the use of this formula, the intermediate speeds are determined by completing the series the same as for Case (1).

The first step in the solution of Case (3) is to find the number of changes. This is accomplished by the use of the formula

$$C = \frac{\log t - \log a}{\log r} + 1 \qquad (2)$$

in which

t = last term of progression;
a = first term of progression;
r = ratio of progression; and
C = number of changes.

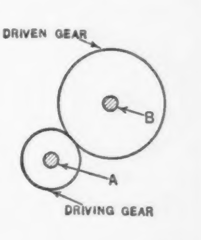
After the number of changes has been found, the intermediate speeds are obtained by completing the series the same as for Case (1).

Before deciding definitely on the number of changes to be employed in any gear set, factors presented in Table 1 should be considered. This table shows the number of gears required to obtain a certain number of feed or speed changes. It is apparent that in a two-gear train (simple gearing using only two change-gears) two, four, six, eight, and ten changes are the most economical as regards the number of gears required, and that in a four-gear train (compound gear using four gears) eight, twelve, sixteen, and twenty changes are the most economical in this respect. Inspection of this table may show how the ratio can be cut down or how the range of speeds can be increased without increasing the number of gears originally provided for.

In determining whether a two-gear or a four-gear train should be used, a great deal depends on the number of changes, the center distance between the driving and driven shafts, the amount of space available, the maximum diameter of gear that can be used, and limitations introduced by the general design of the machine. Generally speaking, a two-gear train should be used when the number of changes is below eight, as this requires fewer gears than a four-gear train for such a small number of changes. The two-gear train can be used for any number of changes, but when the number of changes is eight or over, more gears are required than in a four-gear train, and the gear set will also be more cumbersome. For instance, in a two-gear train giving eight changes in a geometrical progression ratio of 1.414, it is necessary to use eight gears. In this set the diameter of the largest gear will be 3.68 times the diameter of the smallest gear in the set, while a four-gear train giving the same number of changes with the same ratio would require only six gears, and the diameter of the largest gear would only be 1.999 times the diameter of the smallest gear in the set. It is often well to compute gear sets for both two-gear and

TABLE 2. CHANGE-GEAR DATA FOR SET OF TWO GEARS

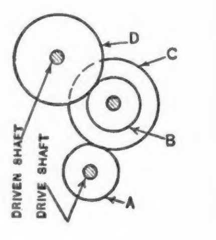
Feed No.	Required Feeds	Gear Ratio	Gear on Shaft A	Gear on Shaft B
1	3.00	1.7469	20	35
2	3.75	1.3975	23	32
3	4.68	1.1180	26	29
4	5.85	......	29	26
5	7.32	......	32	23
6	9.15	......	35	20



Machinery

TABLE 3. CHANGE-GEAR DATA FOR SET OF FOUR GEARS

Feed No.	Feed Required	Ratio A and B	A	B	C	D	Ratio C and D
1	1.00	2.406	20	48	29	60	2.0785
2	1.34	....	..	..	35	54	1.5511
3	1.79	....	..	..	41	48	1.1576
4	2.40	....	..	..	48	41	.....
5	3.22	....	..	..	54	35	.....
6	4.32	....	..	..	60	29	.....
7	5.79	....	48	20	29	60	.....
8	7.75	....	..	..	35	54	.....
9	10.39	....	..	..	41	48	.....
10	13.93	....	..	..	48	41	.....
11	18.66	....	..	..	54	35	.....
12	25.01	....	..	..	60	29	.....



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four-gear trains, and then select the train that best meets requirements.

In Table 4 is given ratios for use in the computation of two-gear trains for two, four, six, eight, and ten changes, and for ratios of progression from 1.10 to 1.60. Tables 5, 6, 7, and 8 give ratios for the computation of four-gear trains, for eight, twelve, sixteen, and twenty changes. The following examples show how these tables and formulas are used in the computation of a two-gear and a four-gear train.

Change-gears of Two-gear Type

Assume that it is required to compute a two-gear train for six changes of feed. The ratio of progression is to be 1.25, and the slowest feed 3 inches per minute. This combination of known factors comes under Case (1), and the first thing that must be done is to complete the series and determine what the successive feeds will be. Doing this, the feeds required are found to be 3, 3.75, 4.68, 5.85, 7.32, and 9.15 inches per minute. The data for the gear set should then be set down as shown in Table 2, the required feeds being placed in the second column. Next a horizontal line should be drawn through the table to divide it into two equal parts, there being as many feed numbers above the line as there are below it. It is only necessary to calculate the gears for the feeds above the line, those feeds below the line being obtained by reversing the order of the gears listed above the line.

Referring to Table 4, we find five gear ratios in the column headed 1.25, but in the left-hand column headed "Number of Changes" we find that only the first three ratios are to be used in a gear set giving only six changes. These three ratios are placed in an inverted order in the third column of Table 2. In order to make Table 4 more compact, the gear ratios therein are given in inverted order, or in just the opposite order in which they are to be set down, as illustrated in Table 2.

The first of these ratios to be taken from Table 4 is 1.7469. Now using a slide-rule, set the left index of the C scale over 1.7469 on the D scale, and then look along the C scale until a whole number is found that exactly or nearly coincides with some whole number on the D scale. It will be found that 20 almost coincides with 35, 23 with 40, 24 with 42, 27 with 47, 28 with 49, etc. Any of these pairs of numbers may be used as the number of teeth in the two gears required to secure the first feed, but in order to keep the gear set as compact as possible, the first two, namely, 20 and 35, are chosen as the numbers of teeth in the first pair of gears. These numbers are entered in columns 4 and 5 of Table 2.

The total number of teeth in these two gears is 55; hence the total number of teeth in the gears of each succeeding pair must also total 55. In order to find the number of teeth in each of the two gears for the second feed, set the slide-rule to the second ratio, namely, 1.3975, and find the two numbers that most nearly coincide, whose sum is 55. These numbers, which are found to be 23 and 32 are entered in the table, the same as the first two were. Following the same method of procedure, the number of teeth in the driving and driven gear for the third feed are found to be 26 and 29, respectively, and these numbers are also entered in Table 2.

We now have the number of teeth required in each of the six gears to give the six changes of feed. Referring to Table 2, it will be seen that the six gears have 20, 23, 26, 29, 32, and 35 teeth, respectively. The gears for feed No. 3 when reversed will give feed No. 4, those for No. 2 reversed will give feed No. 5, and No. 1 reversed will give No. 6. With the gears thus calculated, it only remains to connect the driving and driven shafts of the gear train to the driving and driven members of the machine so that when the gears for any feed are in place, the driven member of the machine will move at the rate demanded by that feed. If this connection is right for one feed, it will be correct for all of them, and any of the six feeds desired may be obtained by using the gears as shown in Table 2.

TABLE 4.- GEOMETRICAL PROGRESSION RATIOS FOR CHANGE-GEAR SETS (TWO-GEAR TRAIN)

Number of Changes	Ratio of Geometrical Progression									
	1.10	1.11	1.12	1.13	1.14	1.15	1.16	1.17	1.18	1.189
2	1.0488	1.0536	1.0583	1.0630	1.0677	1.0724	1.0770	1.0816	1.0863	1.0904
4	1.1537	1.1695	1.1853	1.2012	1.2172	1.2333	1.2494	1.2656	1.2818	1.2965
6	1.2690	1.2981	1.3276	1.3574	1.3876	1.4182	1.4493	1.4807	1.5125	1.5415
8	1.3959	1.4408	1.4868	1.5339	1.5818	1.6310	1.6812	1.7324	1.7848	1.8330
10	1.5355	1.5993	1.6653	1.7332	1.8032	1.8757	1.9502	2.0027	2.1060	2.1792

Number of Changes	Ratio of Geometrical Progression									
	1.20	1.21	1.22	1.23	1.24	1.25	1.26	1.27	1.28	1.30
2	1.0955	1.1000	1.1045	1.1090	1.1135	1.1180	1.1225	1.1270	1.1314	1.1402
4	1.3145	1.3310	1.3475	1.3642	1.3810	1.3975	1.4143	1.4312	1.4481	1.4822
6	1.5774	1.6105	1.6440	1.6780	1.7122	1.7469	1.7820	1.8176	1.8536	1.9269
8	1.8930	1.9488	2.0057	2.0639	2.1230	2.1836	2.2454	2.3083	2.3726	2.5049
10	2.2715	2.3580	2.4470	2.5386	2.6326	2.7296	2.8292	2.9322	3.0370	3.2564

Number of Changes	Ratio of Geometrical Progression									
	1.32	1.34	1.36	1.38	1.414	1.45	1.50	1.55	1.60	
2	1.1489	1.1576	1.1662	1.1747	1.1891	1.2041	1.2247	1.2450	1.2649	.....
4	1.5165	1.5511	1.5860	1.6211	1.6814	1.7460	1.8371	1.9297	2.0239	.....
6	2.0018	2.0785	2.1570	2.2372	2.3775	2.5320	2.7557	2.9910	3.2382	.....
8	2.6423	2.7850	2.9335	3.0874	3.6818	.....	.....	.....	.....	.....

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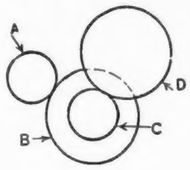
Change-gears of Four-gear Type

As an example illustrating the computations required in designing a change-gear set of the four-gear type, assume that a gear set providing for twelve changes of feed is to be designed. The slowest feed is to be 1 inch per minute and the highest 25 inches per minute. This combination of known factors comes under Case (2), and the first step is to find the ratio of progression. By employing Formula (1), the ratio of progression will be found to be 1.34. Completing the series, the twelve changes of feed required are found to be 1, 1.34, 1.79, 2.40, 3.22, 4.32, 5.79, 7.75, 10.39, 13.93, 18.66, and 25.01.

TABLE 5. CHANGE-GEAR RATIOS FOR EIGHT CHANGES IN GEOMETRIC PROGRESSION



Ratio of Progression	Ratio of A and B Gears	Ratio of C and D Gears
1.100	1.2100	1.1537 1.0488
1.110	1.2321	1.1694 1.0535
1.120	1.2544	1.1853 1.0583
1.130	1.2770	1.2012 1.0630
1.140	1.2996	1.2172 1.0677

Ratio of Progression	Ratio of A and B Gears	Ratio of C and D Gears
1.150	1.3225	1.2333 1.0724
1.160	1.3456	1.2494 1.0770
1.170	1.3690	1.2656 1.0816
1.180	1.3924	1.2818 1.0863
1.189	1.4137	1.2965 1.0904
1.200	1.4400	1.3145 1.0955
1.210	1.4641	1.3310 1.1000
1.220	1.4884	1.3475 1.1045

Ratio of Progression	Ratio of A and B Gears	Ratio of C and D Gears
1.230	1.5130	1.3642 1.1090
1.240	1.5377	1.3810 1.1135
1.250	1.5625	1.3975 1.1180
1.260	1.5876	1.4143 1.1225
1.270	1.6130	1.4312 1.1270
1.280	1.6384	1.4481 1.1314
1.300	1.6900	1.4822 1.1402
1.320	1.7424	1.5165 1.1489

Ratio of Progression	Ratio of A and B Gears	Ratio of C and D Gears
1.340	1.7956	1.5510 1.1576
1.360	1.8496	1.5860 1.1662
1.380	1.9044	1.6211 1.1747
1.414	1.9994	1.6812 1.1890
1.450	2.1025	1.7460 1.2041
1.500	2.2500	1.8371 1.2247
1.550	2.4025	1.9297 1.2450
1.600	2.5600	2.0239 1.2650

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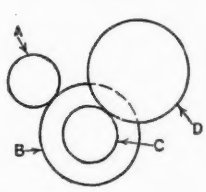
TABLE 6. CHANGE-GEAR RATIOS FOR TWELVE CHANGES IN GEOMETRIC PROGRESSION



Ratio of Progression	Ratio of A and B Gears	Ratio of C and D Gears
1.100	1.3310	1.2690 1.1537 1.0488
1.110	1.3676	1.2981 1.1695 1.0536
1.120	1.4050	1.3276 1.1853 1.0583
1.130	1.4429	1.3574 1.2012 1.0630
1.140	1.4815	1.3876 1.2172 1.0677

Ratio of Progression	Ratio of A and B Gears	Ratio of C and D Gears
1.150	1.5209	1.4182 1.2333 1.0724
1.160	1.5609	1.4493 1.2494 1.0770
1.170	1.6017	1.4807 1.2656 1.0814
1.180	1.6430	1.5125 1.2820 1.0863
1.189	1.6810	1.5410 1.2965 1.0904
1.200	1.7280	1.5774 1.3145 1.0955
1.210	1.7710	1.6105 1.3310 1.1000
1.220	1.8160	1.6440 1.3478 1.1045

Ratio of Progression	Ratio of A and B Gears	Ratio of C and D Gears
1.230	1.8610	1.6780 1.3642 1.1090
1.240	1.9066	1.7122 1.3810 1.1135
1.250	1.9531	1.7469 1.3975 1.1180
1.260	2.0004	1.7820 1.4143 1.1225
1.270	2.0483	1.8176 1.4312 1.1270
1.280	2.0970	1.8530 1.4481 1.1314
1.300	2.1970	1.9270 1.4822 1.1402
1.320	2.2999	2.0020 1.5165 1.1489

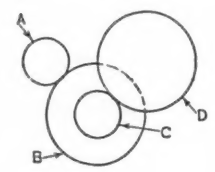
Ratio of Progression	Ratio of A and B Gears	Ratio of C and D Gears
1.340	2.4060	2.0785 1.5511 1.1576
1.360	2.5155	2.1570 1.5860 1.1662
1.380	2.6280	2.2372 1.6211 1.1747
1.414	2.8271	2.3775 1.6814 1.1891
1.450	3.0487	2.5320 1.7460 1.2040
1.500	3.3750	2.7557 1.8370 1.2247
1.550	3.7238	2.9910 1.9297 1.2450
1.600	4.0960	3.2382 2.0239 1.2649

Machinery

Table 3 should next be prepared for a train of four gears, the twelve feeds being entered in the second column. In this case, three horizontal lines should be drawn across the table to divide it into four equal parts. It is only necessary to calculate the gears for one of these parts, the other feeds being obtained by reversing and interchanging these gears. Referring to Table 6, it is found that for a ratio of progression of 1.34, the ratio of the *A* and *B* gears is 2.406, and the three ratios for the *C* and *D* gears are 2.0785, 1.5511, and 1.1576. These ratios should be entered in the third and eighth columns of Table 3.

Now by setting the slide-rule to 2.406, as described in the preceding example, it is found that gears with 20 and 48 teeth may be used for the *A* and *B* gears. These numbers are entered in the fourth and fifth columns of the table. Similarly, the number of teeth in each of the three sets of *C* and *D* gears are found to be 29 and 60, 35 and 54, and 41 and 48. These numbers are entered in the sixth and seventh columns of the table, as shown. The *C* and *D* gears for feed No. 3 reversed will give feed No. 4. The *C* and *D* gears for No. 2 reversed will give feed No. 5, and those for No. 1 reversed will give feed No. 6. Feeds 7 to 12, inclusive, are obtained by reversing the *A* and *B* gears, and using the *C* and *D* gears in the same combinations as for the first six feeds.

TABLE 7. CHANGE-GEAR RATIOS FOR SIXTEEN CHANGES IN GEOMETRIC PROGRESSION



Ratio of Progression	Ratio of A and B Gears	Ratio of C and D Gears	Ratio of Progression	Ratio of A and B Gears	Ratio of C and D Gears	Ratio of Progression	Ratio of A and B Gears	Ratio of C and D Gears
			1.16	1.8107	1.6812 1.4493 1.2494 1.0770	1.240	2.3642	2.1230 1.7122 1.3806 1.1136
			1.17	1.8740	1.7324 1.4807 1.2656 1.0816	1.250	2.4414	2.1836 1.7470 1.3975 1.1180
1.10	1.4640	1.3960 1.2690 1.1537 1.0488	1.180	1.9387	1.7848 1.5125 1.2818 1.0863	1.26	2.5205	2.2454 1.7820 1.4143 1.1225
1.11	1.5180	1.4408 1.2981 1.1695 1.0536	1.189	1.9986	1.8330 1.5415 1.2965 1.0904	1.27	2.6014	2.3083 1.8176 1.4312 1.1270
1.12	1.5736	1.4868 1.3276 1.1853 1.0583	1.200	2.0736	1.8930 1.5774 1.3145 1.0955	1.28	2.6844	2.3726 1.8536 1.4481 1.1314
1.13	1.6305	1.5338 1.3574 1.2012 1.0630	1.210	2.1437	1.9488 1.6105 1.3310 1.1000	1.30	2.8560	2.5049 1.9269 1.4822 1.1402
1.14	1.6890	1.5818 1.3876 1.2172 1.0677	1.220	2.2153	2.0057 1.6440 1.3475 1.1045	1.32	3.0359	2.6423 2.0018 1.5165 1.1489
1.15	1.7490	1.6310 1.4183 1.2333 1.0725	1.230	2.2890	2.0639 1.6780 1.3642 1.1090	1.34	3.2240	2.7850 2.0785 1.5511 1.1576

Machinery

The number of teeth in each of the eight gears required to secure the twelve changes are 20, 29, 35, 41, 48, 48, 54, and 60. With these gears provided, it is only necessary to connect the driving and driven shafts of the gear train to the driving and driven members of the machine, so that when the gears for any feed are in place, the driven member of the machine will move at the rate intended for that feed. If this connection is right for one feed, it will be right for all of them, and any of the twelve feeds desired may be obtained by using the proper gears as given in the table.

The general procedure for the computation of gear sets for a different number of changes than those dealt with in the preceding examples is substantially the same. The main point to be observed is that the table giving the feed numbers in the first column should be divided into two or four equal portions, according to the type of gear train used, that is, whether a two- or four-gear train is to be used, the gears for one of these parts are calculated by means of the ratios in the tables, remaining changes being obtained by reversing these gears. The procedure is very simple, and when once understood is not easily forgotten.

It should be understood that these tables and formulas refer primarily to change-gears mounted on shafts or studs having fixed center distances. As the center distances are fixed, the exact speed or feed desired is not always obtainable; however, this error will rarely exceed 1 per cent. If greater exactness is desired, a four-gear train will be required, and the stud carrying the idler gears must be mounted on a swinging arm so that it will not be necessary to maintain a fixed center distance. The ratios given in the tables apply to this type of construction as well as to that of the fixed-center type.

The ratios given in the tables are also applicable to certain types of quick change-gears. For instance, they apply to that type which consists of two intermeshing nests of cone gears having a sliding key in the shaft that supports one of the cones. With this type of gearing any gear may be made to act as the driver by sliding the key into such a position that it meshes with that particular gear. The computation of this type of gearing is the same as that for a two-gear train of the "pick-off" type, the only difference being that it is necessary to use double the number of gears.

* * *

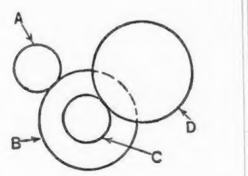
LEARNING THE PATTERNMAKING TRADE

By M. E. DUGGAN

The writer has often been asked to advise young men as to where and how they can learn the patternmaking trade. Perhaps the best way to answer this question would be to cite the case of a young man who began his patternmaking apprenticeship under the direction of the writer when the latter was engaged as foreman patternmaker in a small manufacturing plant.

The young man was employed in the drafting department, and his frequent visits to the pattern shop, where he closely observed the work of the patternmakers, gave him a desire to learn the trade. Accordingly, he took the matter up with the master mechanic, who granted him permission to make the change. The pattern shop was a small one, employing at most not more than three journeymen patternmakers. The patterns were made only for the company's own use, and the plant was located at a considerable distance from any foundry.

TABLE 8. CHANGE-GEAR RATIOS FOR TWENTY CHANGES IN GEOMETRIC PROGRESSION



Ratio of Progression	Ratio of A and B Gears	Ratio of C and D Gears	Ratio of Progression	Ratio of A and B Gears	Ratio of C and D Gears	Ratio of Progression	Ratio of A and B Gears	Ratio of C and D Gears
			1.14	1.9253	1.8032 1.5818 1.3876 1.2172 1.0677	1.200	2.4883	2.2715 1.8930 1.5774 1.3145 1.0955
			1.15	2.0114	1.8757 1.6310 1.4182 1.2333 1.0724	1.210	2.5940	2.3580 1.9488 1.6105 1.3310 1.1000
1.10	1.6104	1.5355 1.3959 1.2690 1.1537 1.0488	1.160	2.1004	1.9502 1.6812 1.4493 1.2494 1.0770	1.22	2.7027	2.4470 2.0057 1.6440 1.3475 1.1045
1.11	1.6750	1.5993 1.4409 1.2981 1.1695 1.0536	1.170	2.1925	2.0027 1.7324 1.4807 1.2656 1.0816	1.23	2.8155	2.5386 2.0639 1.6780 1.3641 1.1090
1.12	1.7624	1.6653 1.4868 1.3276 1.1853 1.0583	1.180	2.2877	2.1060 1.7848 1.5125 1.2818 1.0863	1.24	2.9316	2.6326 2.1230 1.7120 1.3810 1.1135
1.13	1.8424	1.7332 1.5339 1.3574 1.2012 1.0630	1.189	2.3763	2.1792 1.8330 1.5416 1.2965 1.0904	1.25	3.0518	2.7296 2.1837 1.7465 1.3972 1.1178

Machinery

It was evident that the opportunities at this plant for studying the methods of different patternmakers were limited. The variety of patterns made was also limited, and there was no opportunity to study practical molding methods in the foundry in connection with patternmaking practice. For these reasons, the writer did not care to advise the young man to take up the patternmaking trade in this plant, but thought it would be better for him to go to a larger plant, if possible. However, arrangements were made for him to enter the patternmaking shop. He proved to be a hard worker and a student, and each day became more attached to his work.

One morning a notice was received from the master mechanic of the plant to the effect that the existing business conditions made it necessary to lay off the apprentice patternmaker. This was a hard blow to the young man, who had then been at work in the pattern shop for nearly a year. After thinking the matter over, he came to the writer and offered his services for just one-half the wage he was then receiving. As he had a good home with his parents, it was possible for him to do this.

Now the young men who are learning, or thinking about learning, the patternmaking trade would do well to seriously consider the writer's answer to the proposal made by the apprentice patternmaker. This answer was: "No. The time is ripe for you to make a change into a larger and more modern shop, employing from ten to twenty first-class patternmakers. There should be a foundry connected with it. If it is your good fortune to connect with a company having a pattern shop and foundry combined, arrange with your employer to be allowed to spend the first six months in the foundry, and the following six months in the core-room. Win the good will of the workmen in this department, because it is from these men that you will obtain practical information on molding and core-making practice. In this foundry you will see hundreds of patterns of all kinds and construction, made by hundreds of different journeymen and apprentice patternmakers. Study the construction of these patterns and note whether they meet the requirements of the molder and core-maker satisfactorily. Also study the patterns that prove impractical in the molding room or foundry, so that you may be able to avoid the mistakes made in the construction of these patterns."

Continuing, the writer said: "Go into the pattern shop as an apprentice at the end of the year spent in the foundry and core-room. Here it is necessary to study the methods of the journeymen patternmakers and note how they construct their patterns. It is essential to gain the friendship of these men also, as it is principally from them that instructions and information are to be obtained, and not exclusively from the foreman, as some apprentices are led to believe. At the end of the four-years' apprenticeship, if you have not become a practical patternmaker, then the fault is your own.

Do not think, however, that in four years it is possible to have learned all there is to know about molding, core-making, and patternmaking. Become a reader of technical journals. In them many articles that are both interesting and instructive are to be found. The student who reads the best technical journals relating to his work will learn that some other fellow often has a way of doing things that he can employ to good advantage in his own work."

The foregoing advice was followed by the young man, and today he is in charge of the pattern department in one of the largest manufacturing plants in the country.

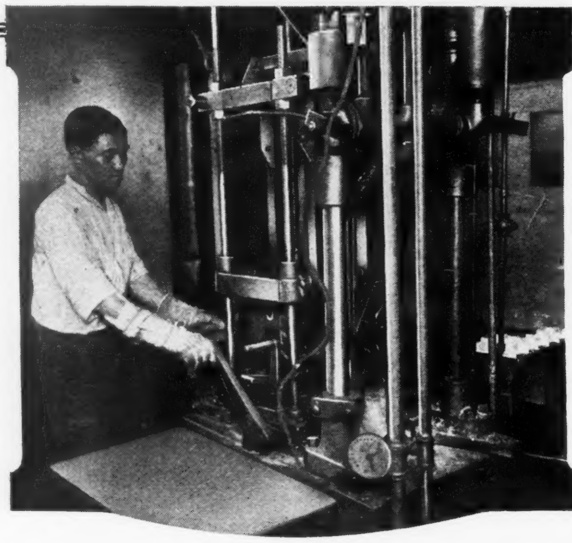
* * *

CARELESSNESS AND ACCIDENTS

A brief analysis of the accidents in a number of textile mills revealed the fact that at the present time most accidents do not occur in connection with the operation of machinery at all. In a woolen mill in Lawrence, Mass., 78 per cent of the lost time due to accidents was from causes that had no connection with machinery. In a cotton mill in the same city, over 82 per cent were due to other causes, and in three other mills, accidents due to machinery were only 15, 16, and 18 per cent, respectively, of the total. Even the comparatively small percentage of accidents due to machinery could be considerably reduced, because from 20 to 25 per cent of these accidents were caused by attempts to clean machinery while it was in motion—an inexcusable carelessness. Accidents due to machinery are becoming comparatively less and less frequent, because most modern machinery is now equipped with gear guards, interlocking safety devices, belt shifters, and other devices that automatically prevent accidents, and those accidents that still occur are very largely due to lack of care on the part of the operator, and can be guarded against only by continued vigilance and instruction.

Die-casting Dies and their Design

BY CHARLES PACK, Vice-president and Chief Metallurgist, Doehler Die-Casting Co., Brooklyn, N. Y.



IN previous articles on this subject, the author has discussed the principles affecting the construction of dies for die-casting, and has described recommended practice in the production of die-castings. The next logical step is to present examples showing the application of the principles stated. This is done in the present article, which contains a description of the most important points of design and construction in a number of die-casting dies. These designs are intended to show, as completely as possible, the methods that may be employed for die-casting white metals into parts of various designs. Practically all die-cast parts contain some special problem, and each must be worked out with the aid of knowledge gained by long experience in the art.

Casting Produced by Sectional Coring

Dies for the fan case of a vacuum sweeper, shown in Fig. 1, form an interesting example of sectional coring. This fan case is an aluminum casting and it will be recognized among the collection of parts shown in Fig. 2. A plan view and sectional view of the ejector die are shown in Fig. 1, as well as a partial view of the cover die through the die impression that produces the angular spout *A*. The problem in this case is the coring of the interior. This is accomplished by a cylindrical core *B* on the end of which is the sprue-cutter; core *B* also embodies sectional cores to form the remainder of the interior. This central core has a key for locating the master section *C*, which, after the central core has been removed, can be drawn radially toward the center. This permits the other core sections to collapse and fall from the casting.

After the central core has been brought into position, the various sections are located around it (including the angular core for the spout), and locked by slides *D* and *E*, which engage grooves in the sections. The pinion for withdrawing the angular core is located at *F*. The ejector die is built out so that the locking projection on the cover die will have a bearing surface on the ejector die at *G*. The dies as well as the central core, are water-cooled. The cooling of the core is accomplished by passing a water pipe into a central hole that is larger in diameter than the pipe, so that the water can drain out around the outside, as shown in the left-hand sectional view.

The assembled sections which fit around the central core also produce a large hole in the fan case. The smaller hole,

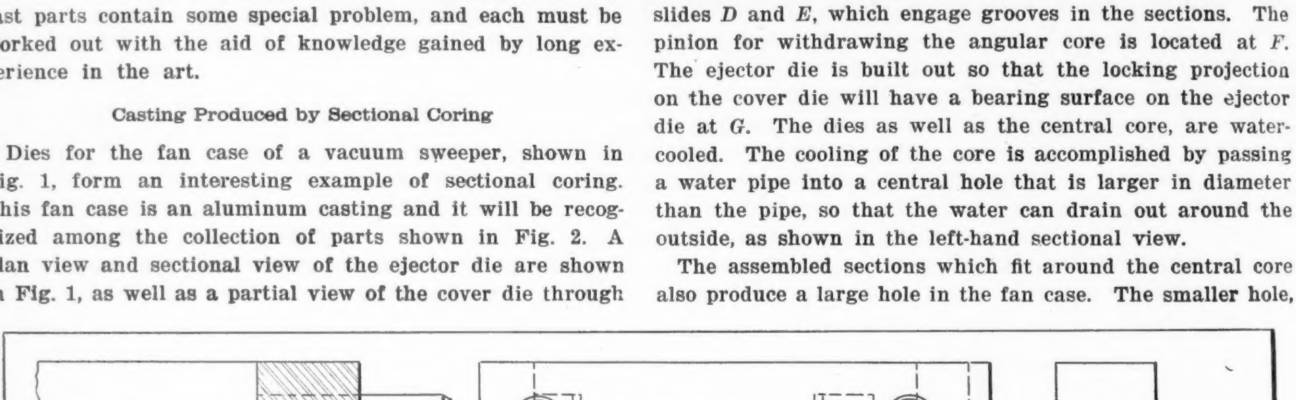


Fig. 1. Plan and Sectional Views of Die for casting Aluminum Fan Case for a Vacuum Sweeper

however, at the front, is not cast through, but its location is indicated in the casting by a slight projection (not great enough to show in the illustration) on the end of core *B*. This thins the metal at the center of the piece so that the hole can be easily punched out in a subsequent operation.

Curved and Angular Coring

An example of core drawing and arrangement that may prove of interest is that used in casting an attachment nozzle for a well-known make of vacuum sweeper. A view of this nozzle is shown at the left in Fig. 2. A detailed drawing of the nozzle is shown in Fig. 3, as well as sectional views of the ejector and cover dies, arranged in the correct relation to each other. The interior of this aluminum casting is produced by two cores, one of which *A* is drawn at an angle by the pinion shown, and the other *B* on a curve, also by a pinion. This special curved core and the angular core are dovetailed together. The shape of the two cores at different portions of this tongue and groove is indicated by sections *C–C*, *D–D*, and *E–E*.

Fig. 2. Interesting Examples of Die-casting

The circular core *B* is locked in position after being slid over core *A* by a wedge *H*, which is operated by a pinion to advance it against the lower end of the curved core. This is the position shown in the illustration. The sprue-cutter *J* is located in back of the angular core, and the metal is fed to the dies through a gate *G* formed by both die members at the end of the casting. This is a case where the location of the gate must be such that the removal of the connecting metal will not impair the appearance of the casting. The cover die is cut out at *F* to fit over the ejector die and seal the mold, the two halves of which are aligned by posts in the regular way.

Dies for Aluminum Skate with Steel Blade Cast in

The skate shown in Fig. 4 is a unique design of die-casting construction in which a steel blade *A* is cast in place. An insert of this kind is rather unusual. The blade is machined with dovetailed slots for anchorage purposes. The location of the two large cores for forming the heel and toe may be seen in the illustration, as well as the position of the gate for feeding metal to the runner portion, heel, and toe. The proportionate size of the feeders to these parts of the skate should be noted.

The dies for casting these skates contain other special features besides the insert, as shown in Fig. 5. They are adjustable for three sizes, insert pieces being used to make up the difference in length. A partial section view of the ejector die and a sectional view of the cover die are shown, these two views being placed in the relation to each other that they would occupy just before closing. As indicated in Fig. 4, there are two large cores used to form the heel and the toe, and the section of the ejector die is taken through the heel core which is designated at *A*. These two large cores are operated in the regular way by a rack and pinion, but they have a special arrangement for casting the small screw holes. This is done by means of cores *B*, which are operated in conjunction with the large cores in the manner described in the following:

When the pinion *C* is turned, the small cores, the large conical core, and the steel piece *D* are withdrawn. The construction provides for an independent movement for the small cores to permit withdrawing them below the surface of the main core, at which time a shoulder on the piece *D* is locked against a corresponding shoulder on the main core which is then withdrawn as the pinion continues to be turned.

The parting line of the die is cut away to provide a seat for the insert blade *E*, which, when properly located, is clamped from the end by a suitable slide. The two dies are aligned by two posts, and a shoulder formed on the two members seals the cavity. This arrangement keeps the dies in accurate alignment, after which they are clamped together by a handle extending from the cover die. The

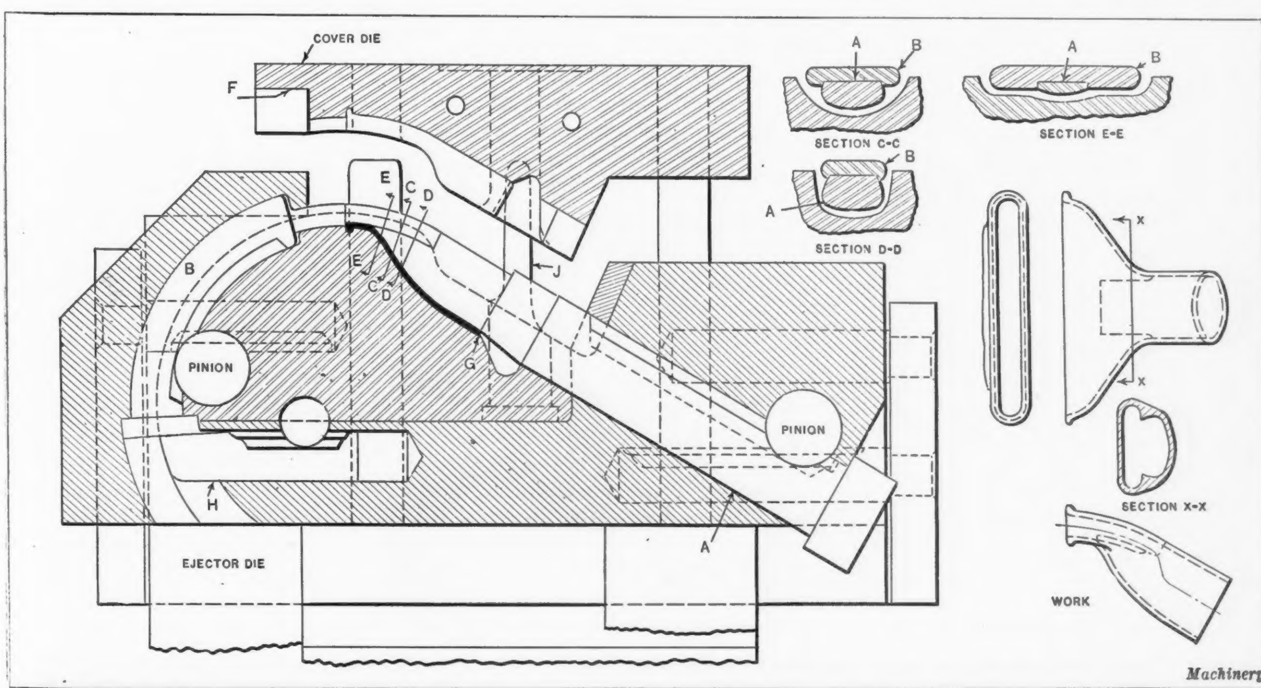


Fig. 3. Sectional Views of Ejector and Cover Dies for casting an Aluminum Attachment Nozzle for a Vacuum Sweeper; also Views of the Work

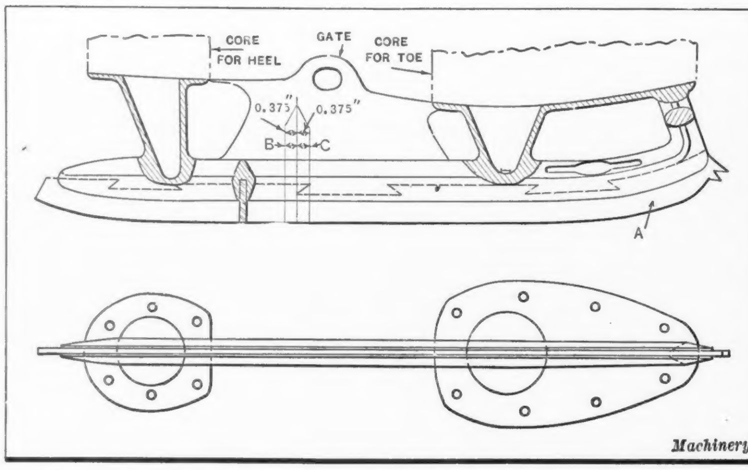


Fig. 4. Aluminum Hockey Skate with Steel Blade cast in Place

adjustable pieces for changing the over-all length of the die impression are 3/8 inch wide, and are set in at *B* and *C* (Fig. 4), elongated slots being provided in the die for properly clamping the adjustable heel sections for different sizes.

In locating the ejector-pins for this casting, several are arranged to bear against the blade, two oval-shaped ones against the thin edge of the toe portion, and one oval-shaped one *H* (see Fig. 5) against the thin edge of the heel portion. Ejector-pins are also used to bear against the gate, and they all move in unison from a common ejector-plate. The sectional view at the right indicates by the space around the base of the sprue-cutter *F*, the sectional shape of the gate. Two of the

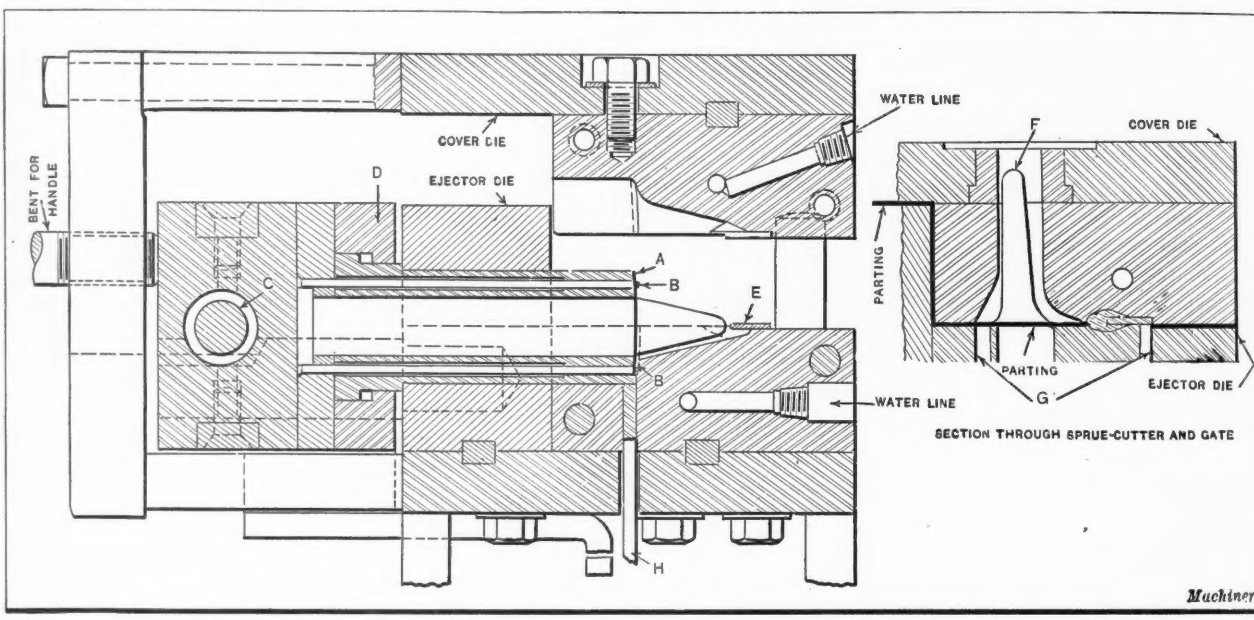


Fig. 5. Sectional Views of Cover and Ejector Dies for Hockey Skate

ejector-pins are shown at *G*, one bearing against the blade and the other against the gate. This gate, of course, is cut off in a subsequent operation. Both die members are water-cooled, the entrance of the water lines being shown in the sectional view of the die at the left in the illustration.

Other Interesting Designs

The automobile steering wheel hub shown in the collection of parts, Fig. 2, is cast with a bearing insert in the central hole. Four angular cores are employed to form the sockets for the wooden wheel spokes. Another good example of die-casting is the large graphophone tone-arm shown directly beneath this hub. This tone-arm has a tapered elbow, produced by two cores drawn from the ends and a third section at the elbow. The three cores fit together in such a way that as much as possible is cast by each end core, the third section remaining in the casting until knocked out through the large end. This can be done without difficulty because the elbow is tapered.

A third casting of interesting design is the drum for a hand knitting machine shown in the upper row of parts. This knitting machine drum is a good example of the saving that results from die-casting parts that otherwise would involve expensive and difficult machining work. In fact, the saving of machining expense, as is well known, is one of the strongest arguments in favor of die-casting. In the case in question, the drum has a large number of narrow slots which must be of accurate width, as the needles that carry the yarn operate in these slots. The exterior of the drum must also have a good finish. All this machining work is obviated by the successful die-casting of the drum, on which no subsequent machine work is required.

Fig. 6. Fruit Juice Extractor, the Principal Parts of which are Aluminum Die-castings

Fig. 6 shows a good example of what can be done with die-castings. Here, practically all the important parts of an aluminum fruit juice extractor are made by die-casting.

* * *

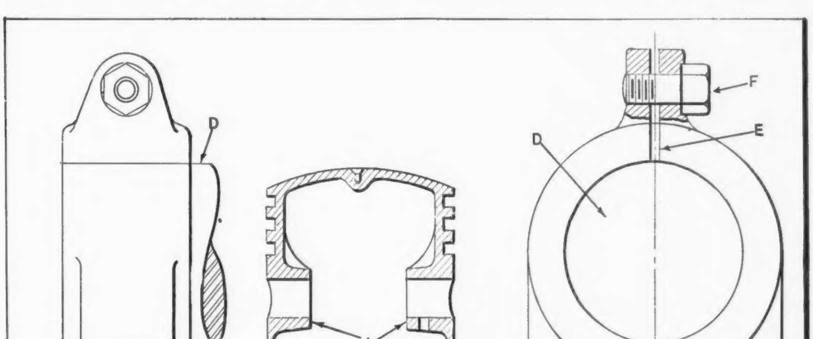
The Machine Tool Trades Association, having 135 members, and representing about 75 per cent of the machine tool makers of England, has decided to hold the next machine tool exhibition from September 5 to 27, 1924, in Olympia; it is expected that by that time improved trade conditions will make the exhibition even more successful than that held in 1920.

Letters on Practical Subjects

OFFSET MILLING HEAD FOR FACING PISTON BOSSES

The offset milling head shown in the accompanying illustration was designed primarily for facing operations on piston wrist-pin bosses such as shown at *A*. In addition to performing this work satisfactorily, the attachment has also proved useful in facing internal bosses on other automobile parts, such as the bosses cast on the inside of differential gear-cases. Cast-iron bracket *B*, which supports the offset head *C*, is bored to a sliding fit on the over-arm *D*. This bracket is split at *E* and is clamped to the over-arm by means of nut *F*. The offset head *C* is a brass casting which, in combination with the brass cover *G*, entirely encloses the train of gears that drive the cutters *H* and *J*. The elongated bosses on the inner sides of the offset head and its cover *G* are bored out to receive the bushings on which the five gears *K*, *L*, *M*, *N*, and *O* are mounted.

Between the inner ends of the bosses and the sides of the gears are placed bronze washers, such as shown at *P*. The shafts on which the gears rotate are ground to a good running fit in the bushing and are made a tight press fit in the gears. Keys are also used to prevent the gears from slipping on their shafts. The three shafts in the center of the offset head are equal in length to the combined thickness of the head and its cover plate. The shaft that is in line with the over-arm support terminates, on the rear side of the housing, in a tapered shank which fits the spindle of the milling machine. This shaft and its attached gear serve to drive the milling cutters *Q* and *R* through the intermediate gears, *L*, *M* and *N*. A right-hand thread is cut in the hole in cutter *R* and a left-hand thread in cutter *Q*. The cutters are tightened against shoulders on the shaft *S* so that a slight clearance is left between the housing and the inner faces of the cutters. Pin-holes are drilled in the cylindrical bodies of the cutters to facilitate tightening them on the shaft.



Milling Machine Attachment used in finishing the Faces of Bosses such as shown at A

As the thickness of the cutters is reduced by regrinding, shims are placed in back of them so that the required distance between the faces of the milling cutters is maintained. Before assembling cover *G* on the offset head, transmission oil is poured into the housing, and a gasket is placed between the cover and the housing so that the oil cannot leak out when the attachment is in operation.

Brooklyn, N. Y. JOHN A. HONEGGER

MACHINING BUSHINGS ON A VERTICAL DRILLING MACHINE

The writer was recently employed in a factory where large quantities of cast-iron parts were made. In this plant thirty turret lathes were kept in continuous operation on different parts. In fact, the lathes were so crowded with work that they were kept running from twelve to fourteen hours a day. In the department with the turret lathes there were three vertical drilling machines that stood idle most of the time. So the foreman of the department decided to use these machines for some of the work regularly done on the turret lathes. Accordingly, he devised the tools described in the following for machining the cast-iron guide bushing shown at *C* in Fig. 1. The required production on this job was 500 finished parts per day. This necessitated the continuous operation of two turret lathes.

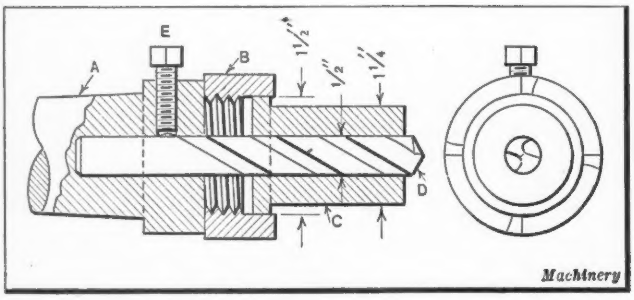


Fig. 1. Tool used on Vertical Drilling Machine for First Operation on Bushing C

The bushing was machined in three operations on the vertical drilling machine, although, by making a slight change in the tool used for the first operation, the work could have been done in only two set-ups, as was the case when machining the part on a turret lathe. It is evident that the facing tool shown in Fig. 2 could have been combined in some way with the tool *B*, Fig. 1. In the first operation, tool *B* turns or hollow-mills the 1½-inch diameter of bushing *C* and drills the ½-inch hole. The tool-holder *A* is made of machine steel, one end being tapered to fit the spindle of the drilling machine, and the other drilled to take a standard twist drill, which is held in place by the set-screw *E*. The hollow mill *B* is made of high-speed tool steel and threaded to fit the end of shank *A*.

In Fig. 2 is shown the attachment used for the second operation, namely, facing the flanged end of the bushing. The same shank *A* as was used in the first operation is employed to hold the cutters *K*, which are made of high-speed steel and held in place by set-screws, as shown. A steel pilot about 0.495 inch in diameter is used to steady this tool and prevent chattering. The tool used to turn the 1¼-inch diameter and face the flange and the opposite end of the bushing is shown in Fig. 3. It consists of two turning tools *I*, one facing tool *J*, two adjusting screws *L*, four set-screws, an upright pilot *H*, 0.495 inch in diameter, and a cast-iron body *F*.

In the first operation, the work is held in a wrenchless three-jaw chuck (not shown) which is attached to the table of the drilling machine. The machine is run on the third

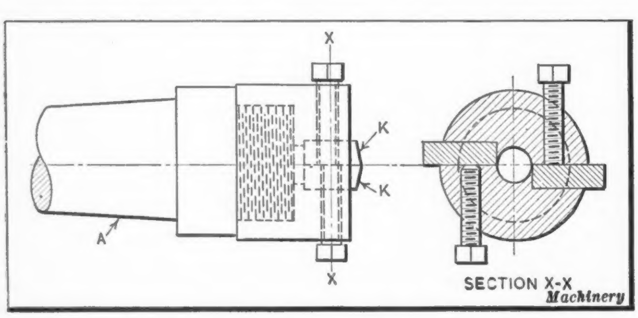


Fig. 2. Tool used for Second Operation on Bushing shown in Fig. 1

speed, the drill *D*, Fig. 1, being used to drill the hole and also to serve as a pilot while the flange is being turned by the hollow mill *B*. In the second operation, cutters *K* are assembled on shank *A*, as shown in Fig. 2. The second speed of the drilling machine is used for this operation, and the chuck employed in the first operation is used to hold the work.

In the third operation, the 1¼-inch diameter is turned, the inside of the flange faced, and the opposite end of the bushing faced A special pair of jaws *G* shown in Fig. 3 is used to hold the work during this operation. The lower face *M* of these jaws serves as a positive stop for locating the work, and the facing stop of the drilling machine spindle is set in the regular way to insure machining all bushings to a uniform length. In this or either of the two preceding operations, it is not necessary to use the power feed, as good results are obtained by using the hand feed only.

The most essential point to bear in mind in operating the tools shown in Fig. 3 is to keep the cutters *I* ground so that each will take the same depth of cut. The sides of these tools have a shaving action that gives a smooth finish. The use of the vertical drilling machine, as described, relieved the turret lathes of some of their excess work, and it was found that the production rate was 30 per cent greater than with the turret lathes. With the latter it was necessary to stop the machines in order to remove

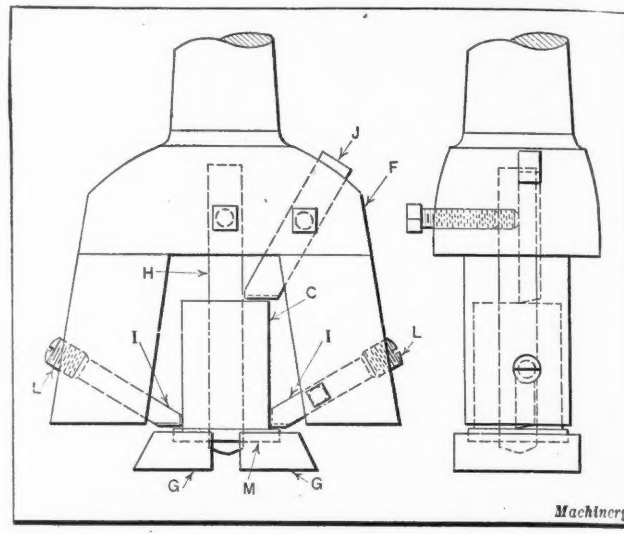


Fig. 3. Facing Tool employed on Vertical Drilling Machine

a finished part and put in an unfinished piece, whereas with the drilling machines, the work could be removed and a new piece inserted without stopping the machine spindle.

Cicero, Ill. JOHN J. BORKENHAGEN

SKELETON PATTERNS FOR WATER-PIPE JOINT RING

Skeleton patterns and core-boxes of the type used in making the mold for the water-pipe joint ring shown in Fig. 1 may be used to advantage in the production of a variety of castings. In this case only one casting was required, but it was necessary that it be produced quickly. As no machine work was to be done on the casting, it was required to be quite accurate as to size and form.

To have made a full ring pattern, split through the middle, as was originally intended (the pattern to be molded on edge with the center formed by a core made in a core-box) would have necessitated the use of a large amount of lumber and consumed considerable time. To construct the pattern with the idea of molding the ring on its side in green sand is, in the writer's opinion, both impracticable and a waste of time. Instead of using this method, the ring was molded and cast in dry sand cores.

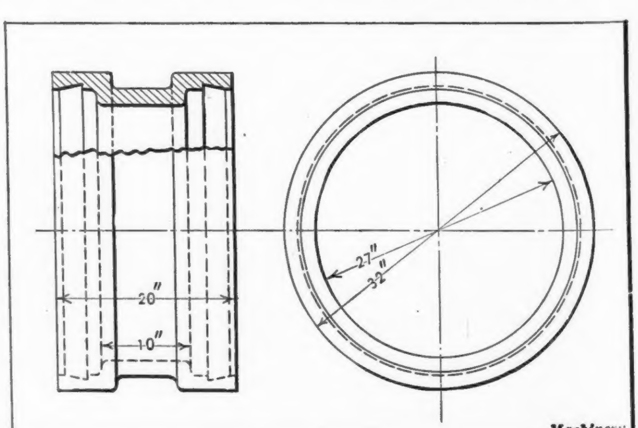


Fig. 1. Water-pipe Joint Ring

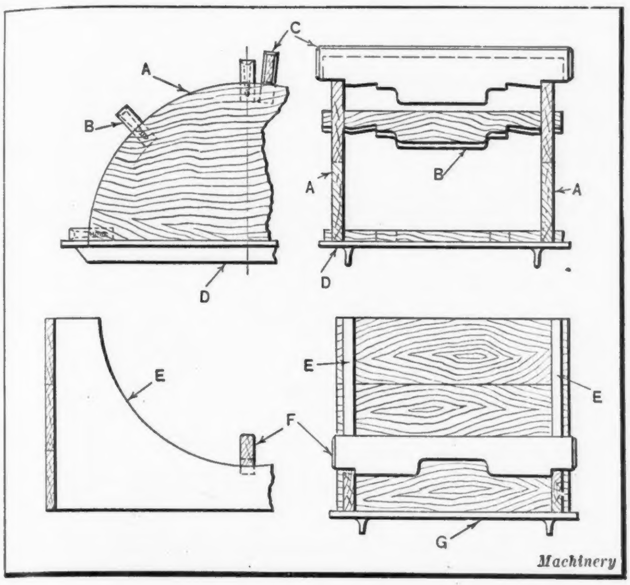


Fig. 2. Skeleton Molds used in making Ring Casting shown in Fig. 1

The skeleton pattern or core-boxes used in making the mold are shown in Fig. 2. Two half-circular sides *A* were used in making the core that formed the inside of the ring. The sides were held together by five tie-pieces like the one shown at *B*. The tie-pieces, together with the strickle board *C*, were cut at one time on the band saw to the same shape as the inside of the ring, and the tie-pieces were fastened in place by screws.

The skeleton half-core box is shown on the dryer plate *D* ready for making the half-core. The procedure in making the core was as follows: Two or three inches of sand was shoveled on the dryer plate and roughly leveled off. On this bed of sand was placed round or square iron rods, which were rammed up and baked in the core to give the mold the necessary strength. Without these pieces, the core would be likely to fall apart when handled. The sand was then filled in between the sides or ends *A* of the skeleton frame, and smoothed off or formed with the strickle board shown at *C*. Two half-cores produced in this manner were baked in the core oven, after which they were pasted and wired together to form the full inside core. Attention should be called to a mistake that was made in constructing the original skeleton core-box, which caused a delay in the work. Instead of cutting the five tie-pieces to the shape of the inside of the ring, the patternmaker made them plain and straight across on their faces. This mistake was discovered, however, and the skeleton box returned to the patternmaker for correction. However, the correction could easily have been made in the core-room by simply removing one tie-piece at a time, filling in sand, going over the spot with the strickle board, and then replacing the tie-piece.

The skeleton box used in making the outside section of the dry sand mold is shown in the two lower views, Fig. 2. The side or end boards *E* were sawed to shape on the band saw, but in this case, the strickle *F* is shaped to correspond with the outside of the work. The two outside half sections required to complete the outer member of the mold were made in the same manner as the inner core, the half members being molded on the core-plate *G*. After being baked, the half members were pasted and wired together to form the complete outer member of the mold.

Kenosha, Wis. M. E. Duggan

LABORATORY TESTS REDUCE GRINDING WHEEL EXPENSE

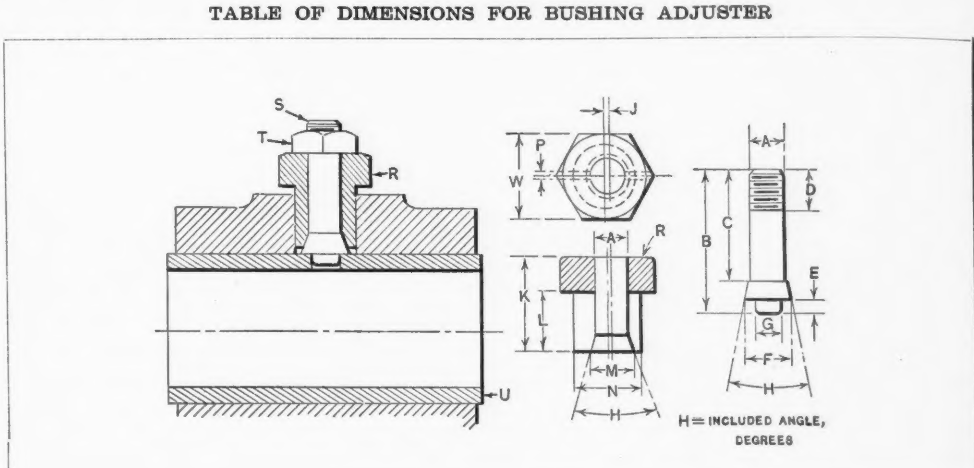
In a certain plant about one thousand grinding wheels (costing $30 apiece) were used each year in performing a special grinding operation. It was found by the cost department that the life of these wheels was far from uniform. While one wheel might be efficient, another would not stand up long enough to pay for setting it up. Realizing that the company was losing money on many grinding wheels, the laboratory was called upon to find out which wheels could be used profitably and which ones should be rejected. The wheels all came from one manufacturer, and all were supposed to be of the same grit, grade, and bond. The laboratory developed a scheme of testing, including visual inspection, screwdriver tests, and microscopic examination. These tests resulted in a saving of $10,000 in the first year. It also made the manufacturer more keenly alive to his responsibilities, and he made a greater effort to make his product more uniform. This is only one of many instances wherein the works laboratory of this plant has cut down expenses by the application of scientific tests to production problems.

Philadelphia, Pa. Arthur L. Collins

END THRUST ADJUSTMENT FOR BUSHING

The wear on the end of a bearing bushing caused by the end thrust of a revolving hub, gear, worm-wheel, or other part often necessitates the provision of some means of adjusting the bushing longitudinally in its housing in order to take up the lost motion. The device illustrated in connection with the accompanying table provides a simple means of obtaining the required adjustment and is particularly well adapted for use on medium weight automatic

TABLE OF DIMENSIONS FOR BUSHING ADJUSTER



A	B	C	D	E		G	H	J	K	L	M	N	P	W
3/16	3/4	19/32	1/4	1/16	1/4	0.132	30	1/32	33/64	31/64	15/64	5/16	1/32	5/16
1/4	1 1/16	55/64	5/16	3/32	11/32	3/16	30	3/64	11/16	7/16	5/16	7/16	1/32	3/8
5/16	1 1/4	63/64	3/8	1/8	27/64	1/4	30	3/64	13/16	1/2	25/64	9/16	3/64	7/16
3/8	1 1/2	1 11/64	7/16	5/32	1/2	5/16	30	1/16	1	5/8	15/32	11/16	3/64	9/16
7/16	1 3/4	1 25/64	11/16	3/16	37/64	11/32	30	1/16	1 1/8	11/16	35/64	3/4	1/16	5/8
1/2	2	1 17/32	11/16	7/32	43/64	13/32	30	1/16	1 5/16	13/16	41/64	7/8	1/16	11/16
9/16	2 1/8	1 5/8	3/4	1/4	47/64	7/16	30	1/16	1 3/8	7/8	45/64	15/16	1/16	3/4
5/8	2 3/8	1 13/16	3/4	5/16	51/64	1/2	30	1/16	1 1/2	1	49/64	1 1/16	1/16	13/16

Machinery

machinery. The dimensions in the table cover a range of sizes that meet all ordinary requirements.

The adjuster consists of a bushing *R*, a stud *S*, and a nut *T*. The small end of the bushing *R*, which fits into a hole drilled in the bushing housing, is slotted. The stud *S* fits an off-center hole in bushing *R*. When stud *S* is tightened, it forces the slotted end of the bushing to expand and grip the housing. On the head of the stud is a small pin, which is a close fit in a hole in the wall of the shaft bushing *U*. The parts *S* and *T* should be made of tool steel and hardened. To take up wear, the nut *T* on the end of the stud is loosened to allow the eccentric bushing to be turned the amount required to take up the space between the end of the bushing and the hub, or whatever part exerts the thrust on the bearing. After the adjustment is made, nut *T* is tightened so that the shaft will be held in a fixed position. The bushing should extend beyond the end of the casting to insure contact with the revolving member on the shaft.

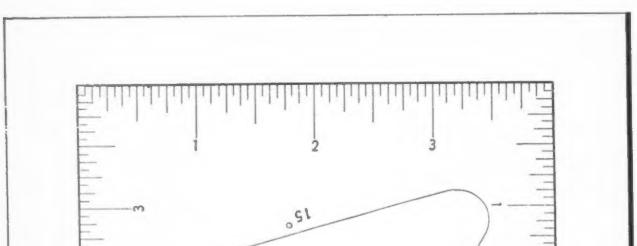
Hempstead, L. I. GEORGE E. HALL

DRAFTSMAN'S COMBINATION SCALE AND ANGLE

The draftsman's combination scale and angle illustrated may be made from celluloid, German silver, or almost any thin sheet metal. It will be noted that the device is square on the outside and is graduated on all four sides. The graduated sides enable the draftsman to measure or lay out dimensions on either a horizontal or a vertical line without the use of a regular scale. In the center of the square, is cut a triangular-shaped opening that will give a combination of 15, 30, 45, 60 and 75 degrees. This in itself is something that the standard draftsman's angles will not give without the combination of the 45- and 60-degree triangles.

The most satisfactory results are obtained by making the instrument of celluloid. In this case, the scale graduations are put on the bottom, and filled in with some kind of blacking. As the celluloid is transparent, it enables work to be drawn up to a very accurate scale. Any line on the bottom of the graduated scale can be made to coincide with any line previously made on the drawing. With this instrument the draftsman can measure along any of the four graduated sides, and does not have to drop his pencil and pick up a scale, in order to lay off a dimension on either a vertical or a horizontal line.

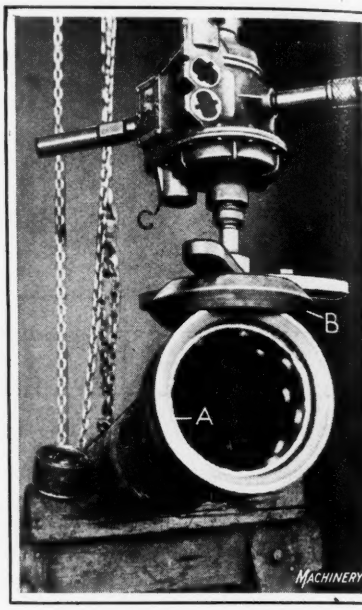
Bridgeport, Conn. GUSTAVE F. BAHR



Combination Scale and Angle

LAPPING JOINTS OF LOCOMOTIVE STEAM PIPES

An improvement over the old hand method of lapping the joints of locomotive steam pipes is described in the following: These joints are of the ball and socket type used to connect the ends of the seamless steel pipes or tubes which lead from the superheater to the locomotive cylinders. The swaying of the locomotive when going around curves, unevenness of the road bed, etc., gives these tubes a "weaving" motion that would quickly cause leakage if the pipe connections were of the usual type employed for stationary engines.



Air-operated Tool used in lapping Joints of Locomotive Steam Pipe

Referring to the accompanying illustration, the end of one of the pipes is shown at *A*. The method of attaching the pipe joint sleeve to the pipe is apparent. The steel joint ring is shown at *B*. The ball and socket surfaces of these two elements are first machined in a lathe to as nearly a perfect fit as can readily be obtained. In order to insure a steam-tight joint, however, it is necessary that the two surfaces be lapped in contact with each other until a practically perfect fit is obtained. The lapping of these elements was formerly done by hand, the parts being rotated together after placing a quantity of abrasive material between the joint surfaces. This was a slow and tedious method, as the workman had to exert the pressure required to hold the parts in contact, besides rotating the ring, and the results were not always satisfactory.

With the improved method of lapping by means of an air-operated machine, the results obtained were all that could be desired. The joint ring *B* is held with a clamp type of chuck to the spindle of the machine shown at *C*. This machine is of a commercial type used extensively for drilling and similar work, and is one of the tools commonly found in railroad repair shops. The ring and pipe are brought in contact after abrasive has been placed on the joints. Air is admitted to the machine, causing the spindle to revolve at a speed of approximately 85 revolutions per minute. The joints are quickly ground or lapped by this process. The ring is next reversed in the holder and placed against the other mating surface located on the superheater. The air-operated machine can be used in any part of the plant, the only requirement being that sufficient rubber piping be provided to connect it with the air supply pipe.

Providence R. I. ROBERT MAWSON

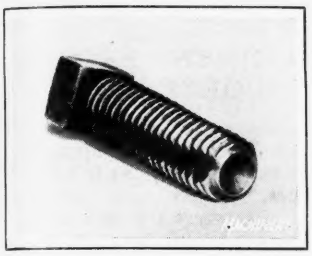
* * *

A new development in motor truck transportation is the use made by the railroads of this means of freight haulage for overcoming terminal congestion. Instead of distributing less than carload freight between different terminals by means of shuttle cars, the railroads have found it more feasible to have motor trucks transfer the freight from one depot to another. It is said that not only does this system relieve freight congestion at the terminals, but that this kind of short haul work can be done quicker and at less cost by motor trucks than by the shuttle trains.

Shop and Drafting-room Kinks

CLEANING TAPPED HOLES AFTER HARDENING

It is often necessary to run taps through threaded holes in pieces that have been hardened, in order to clean out the scale or carburizing material left in the threads. This work quickly dulls the tap, and in the case of small holes results in frequent breakage of the taps. The writer has found that an ordinary set-screw with three grooves ground in its sides will do this work as well as a tap, and eliminates the expense due to tap breakage which in some cases amounts to a considerable sum.



Set-screw used for cleaning Tapped Holes

In the accompanying illustration is shown a set-screw as it appeared after having been used to clean out over fifty tapped holes in hardened pieces. There are three equally spaced grooves ground in the sides of the set-screw, although only one groove can be seen in the illustration.

Ypsilanti, Mich. FLOYD GRAVES

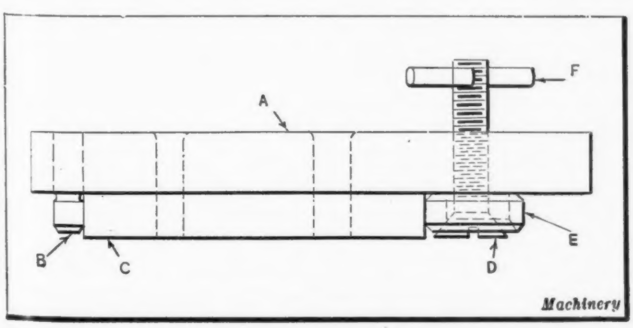
BEVELED OIL-CAN SPOUT

When used in conjunction with the common ball type of oiler, an oil-can spout should be beveled off at an angle of about 45 degrees to permit the oil to flow freely into the oiler. P. R. H.

DRILL JIG FOR SMALL FLAT PIECES

A simple drill jig for holding flat pieces is shown in the accompanying illustration. The writer has found this type of jig particularly well adapted for use in drilling small parts such as are used in the construction of radio equipment. The part *A* is the drill plate, and it may be fitted with drill bushings, or properly located holes may serve as guides for the drills. The work *C* to be drilled is clamped between the stop-pin *B* and the ring *E* by tightening screw *D* so that the conical part of the flat head of the screw will force ring *E* into contact with the work.

Ring *E* is made from a short piece of steel tubing, and is countersunk to provide a good contact surface for the conical part of screw *D*. The screw is provided with a cross-pin *F*, which facilitates clamping and releasing the work. When the jig is loaded, the center of screw *D* is nearer the end of the work than the center of ring *E;* consequently when the screw is tightened, the head tends to center itself in the countersunk end of the ring, thereby forcing the latter over toward the stop-pin, which results in securely clamping the work in the jig.

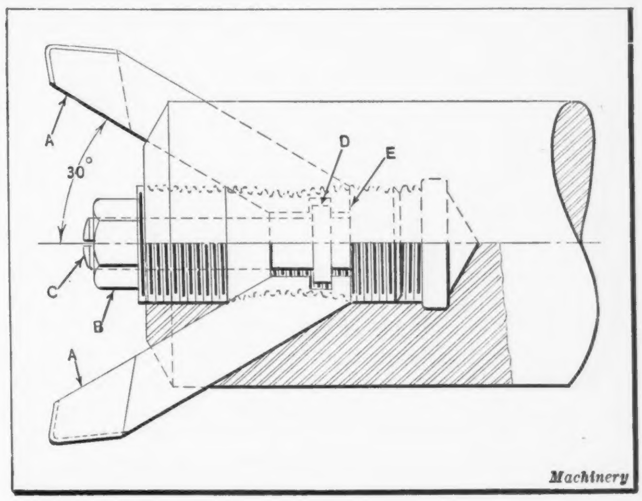


Drill Jig for Small Flat Pieces

Weehawken, N. J. O. F. ROTHEN

ADJUSTABLE BORING-BAR HEAD

The boring-bar head illustrated was designed by the writer for use on a four-spindle boring machine employed in boring automobile truck engine cylinder blocks. The boring head is provided with a means of adjusting the cutters through a distance of 3/16 inch on the diameter. The method of adjustment needs but little explanation. The cutters *A* are set at an angle of 30 degrees, and are made a sliding fit in the square holes in the boring-bar head. The inner end of the cutters is grooved to receive the collar *D* on screw *C*. It will be noted that the inner end of the cutters rests on the shoulder *E* of screw *C*, which forms a substantial stop. By screwing *C* in or out, the cutters are drawn inward or fed outward, thereby decreasing or increasing the cutting diameter. After the cutters have been adjusted to the required diameter, part *B* is screwed down tight, thus clamping the cutters in position.



Double-cutter Adjustable Boring-bar Head

Winnipeg, Canada J. T. LONGDON

DRAWING-BOARD SLIDE-RULE

There are few designers who cannot use a slide-rule to good advantage in their daily work. However, to obtain the best results, a slide-rule three or more feet in length should be employed. Some years ago, the writer made up a slide-rule that formed an integral part of his drawing-board. It was made 8 feet long or the same length as the drawing-board and was provided with four sets of graduations, universally known as the A, B, C and D scales.

A strip of cherry reglet, such as may be obtained from a dealer in printers' supplies, makes a very serviceable slide for a drawing-board slide-rule. The strip should be about 1/6 inch thick. A channel or groove is planed in the drawing-board to receive the slide, which should be made a smooth sliding fit in the groove. The slide should be fastened in the groove temporarily while the graduations are being made with a sharp-edged tool. The graduations can be laid off to scale by the use of a standard sized slide-rule, or they may be laid off according to mathematical calculations.

New York City ROBERT GRIMSHAW

Questions and Answers

MANUFACTURE OF COLD-ROLLED STRIP STEEL

B. H. H.—The writer would like information on the manufacture of cold-rolled strip steel, such as is used for light stampings.

A.—To answer this question completely in this column would require too much space, but the subject is quite completely covered in the book entitled "Iron and Steel," published by THE INDUSTRIAL PRESS. The process is treated from the time the ribbon stock is received for annealing, and covers the various annealing processes, types of furnaces used, descriptions of the pickling and rolling operations, etc. The amount of reduction that is obtainable in each step in the rolling process is given as well as the subsequent operations performed on the strip stock, such as trimming the edges and finishing them, cutting the strips into lengths, hardening and tempering, and final polishing. The furnaces and other equipment used are illustrated.

STANDARD AND SPECIAL TOOLS

H. F. K.—What is the difference between a standard and a special machine or tool, as these terms are generally applied in the machine-building field?

A.—A standard machine or tool differs from a special design, according to the general use of these terms in the machine tool field, in that it is applicable to general work instead of being designed for a special purpose. For instance, standard machine tools may be used for performing operations on miscellaneous classes of work within their range, in an order or sequence that may be varied according to requirements. An engine lathe is an example of a standard machine; whereas a machine designed exclusively for drilling holes in crankcases or some other part illustrates the special or "single-purpose" type of tool, which is found in automobile plants or wherever the production is on a large enough scale to warrant using special machines. While a tool such as a tap is intended to produce a screw thread of given diameter and pitch, it might properly be classified as standard, because the application is not restricted and it can be used in the production of miscellaneous classes of work. A special tool is limited in its use to one specific line of work. A jig designed for drilling a certain part is an example of special tool equipment.

CENTER OF GRAVITY AS RELATED TO VOLUME

B. O.—After finding the center of gravity of the frustum of a pyramid by the formula on page 269 of MACHINERY'S HANDBOOK, the volume on each side of the center of gravity was determined by the use of the formula on page 136, but the volumes were not equal on each side of the center of gravity. Please explain why these volumes do not balance.

A.—Evidently you have assumed that the volume should be equal on each side of the center of gravity, which may not be the case. The center of gravity is the point at which the body may be balanced or the point at which the entire weight may be considered as concentrated, but it does not follow that the center of gravity is a central point dividing the body into two equal volumes. Two balls of unequal diameter mounted on the ends of a pivoted rod, will doubtless serve better as an illustration than the pyramid. If the weight of the small ball is represented by w, the weight of the large ball by W, and the distances to the center of gravity (opposite the pivot) are represented by X and Y, then $w \times X = W \times Y$. In other words, the center of gravity is the center of moments, and in this example there may be considerable difference between the two weights and also between the volumes; consequently the smaller ball will be much farther from the center of gravity than the larger one. The same principle holds true in the case of the pyramid.

DOES A PATENT ASSIGNMENT BECOME VOID IF NOT RECORDED?

L. D. M.—I am the owner by assignment of an undivided one-half interest in a United States patent. The assignment was executed more than six months ago, but it has not been recorded in the Patent Office. I have been informed that my assignment is void, as against the rights of one purchasing a half interest subsequent to the assignment to me, for the reason that I permitted a period of more than three months to elapse after the purchase without recording it in the Patent Office. Will you please advise me whether or not this is correct?

ANSWERED BY GLENN B. HARRIS, YONKERS, N. Y.

Your inquiry may be answered "yes" and "no." That part of the revised statutes relating to patents provides that an assignment, grant, or conveyance of a patent or of any interest in one, will be void without notice, against any subsequent purchaser or mortgagee for a valuable consideration, unless recorded within three months of the date of the assignment or prior to the recording of the subsequent purchase or mortgage. In your case, as the assignment is of one-half interest, the assignor was free to dispose of the remaining half interest without in any way impairing the validity of your ownership, unless still another conveyance of a half interest had been made. In any event both of these transfers must be a matter of record in the Patent Office prior to the filing of your own assignment, in order to affect the validity of your assignment. Your assignment should be recorded immediately.

COLORING SHEET BRASS

R. L.—Have you any information on methods of artificially coloring sheet brass for ornamental purposes?

A.—Metal may be artificially colored by mechanical means or by electro-chemical deposition. By the latter method, the colorings are modified by the temperature of the solution used and the strength of the electric current employed. The mechanical method is simply that of applying a paint, lacquer, or bronze powder with a brush, but this would not be applicable for the purpose stated, as by this method no physical combination is formed with the metal to be coated. In a book entitled "Metal Coloring and Bronzing" by Arthur H. Hiorns, it is stated that the ingredients and temperature of the solution and the length of time that the metal is immersed, influence the coloring of brass by the electro-chemical process. For example, a solution of one part copper chloride and one and one-half parts water at various temperatures gives brass colorings ranging from brown to greenish-drab. A solution of ferric chloride and copper chloride, one part each, and twenty parts water gives brass various colorings of a bronze hue. The temperature of this solution may be varied from 59 to 176 degrees F., and the length of immersion should be from one to five minutes, these factors being variously combined to give the desired tone. There are many kinds of solutions used in coloring brass, depending on the color wanted.

NOMENCLATURE OF POWER-PRESS PARTS

The various parts embodied in common machine tools, such as the lathe, drilling machine, shaper, and planer, are almost universally known by the same terms, but when it comes to the power press, misunderstandings are frequent, because the parts are called by different names in different localities. A few of the names applied to the reciprocating member of the power press to which the punch is attached are as follows: Slide, ram, plunger, cross-head, mandrel, gate, sash, sliding head, head, and punch-carrier. While some of these terms are sufficiently descriptive to enable one to realize quickly what part is meant, others give no clue whatever. Obviously, when a term of the latter class is used in correspondence, especially in ordering repair parts; time is lost in ascertaining what part is referred to.

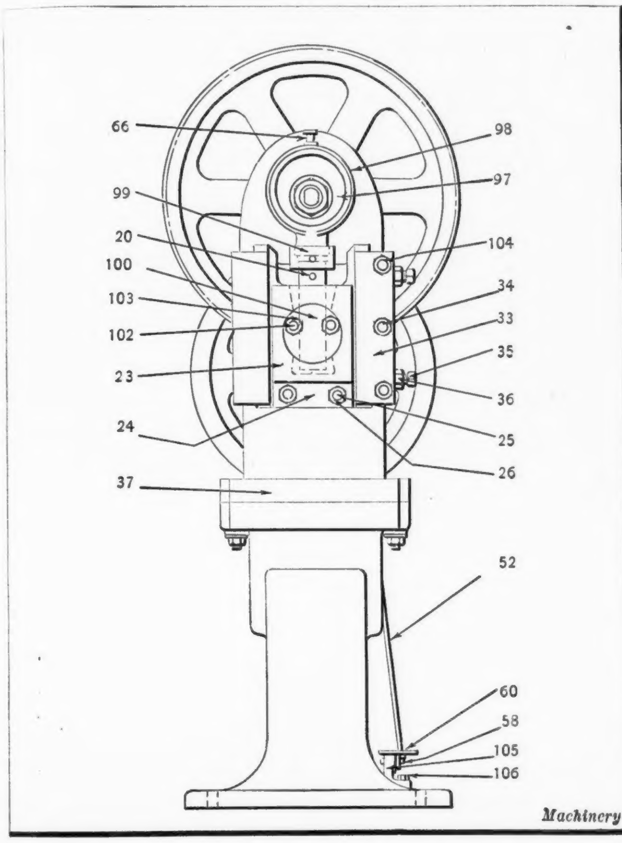


Fig. 1. Drawing of a Power Press in which the Numbers refer to the Accompanying List which gives Names for the Various Parts

Various terms are also used to identify the same style of press, as for instance "straight-column," "straight-sided," and "straight-sided pillar" or "arch" and "inclined-upright pillar." Even the machine itself is sometimes called a power press and sometimes a punch press; in the latter case, it may be confused with a machine for punching holes in plates.

In order to eliminate confusion in ordering parts for replacement purposes and also with a view to standardizing the nomenclature of power presses, the Toledo Machine & Tool Co., Toledo, Ohio, has included in a recent catalogue, line drawings of the more common types of presses on which reference numbers lead to the various parts, as well as halftone illustrations of the principal parts, which are also identified by reference numbers. In connection with these illustrations are lists which give the preferable name for the parts that are numbered. Halftone illustrations and lists of names are also given for the parts contained in the clutch with which Toledo presses are equipped.

Two of the line drawings from this catalogue are reproduced in Figs. 1 and 2, and their identification list is given in the following, this list including every part on the press, whether shown in the illustration or not:

Press Not Geared

No.	Name	Number on Each Press
1	Frame	1
*4	Clutch flywheel	1
5	Crankshaft	1
*6	Brake (and drive) collar	1
8	Brake band complete with lining	1
9	Brake band attaching stud	1
10	Brake band attaching stud nut	1
11	Shaft washer and pin (rear)	1
12	Clutch collar key	1
13	Shaft nut (rear)	1
20	Connection screw	1
23	Slide	1
24	Slide recess cap	1
25	Slide recess cap stud	2
26	Slide recess cap stud nut	2
33	Gib	1
34	Gib stud	3 or 4
35	Gib adjusting set-screw	2 or 3
36	Gib adjusting set-screw nut	2 or 3
37	Bolster plate	1
38	Bolster plate bolt	4
39	Bolster plate bolt washer	4
40	Bolster plate bolt nut	4
52	Treadle connection rod	1
58	Treadle shaft	1
60	Treadle	1
*61	Treadle connection screw adjusting bar	1
*62	Bolster bolt wrench	1
*64	Brake band wrench	1
*65	Set-screw wrench	1
66	Oil-cups	

Press Geared

No.	Name	Number on Each Press
*67	Back-shaft bracket	1
*68	Back-shaft bracket stud	4
*69	Back-shaft bracket stud nut	4
*70	Back-shaft bracket cap	1
*71	Back-shaft bracket cap stud	4
*72	Back-shaft bracket cap stud nut	4
73	Back-shaft or pulley stud	1
74	Pinion	1
76	Balance wheel	1
78	Loose pulley	1
79	End collar	1
80	End collar set-screw	1
81	Clutch gear	1
*82	Gear guard	1
91	Eccentric key	1
92	Crankshaft bushing	1
93	Pulley stud end	1
94	Pinion balance wheel cap-screw	2
95	Crankshaft nut (front)	1
96	Crankshaft nut washer (front)	1
97	Eccentric	1
98	Eccentric strap	1
99	Adjusting lock-nut	1
100	Connection pivot (front)	1
*101	Connection pivot (rear)	1
102	Connection pivot screw	2
103	Connection pivot screw nut	2
104	Gib stud nut	3 or 4
105	Treadle lug	1
106	Treadle lug screw	1

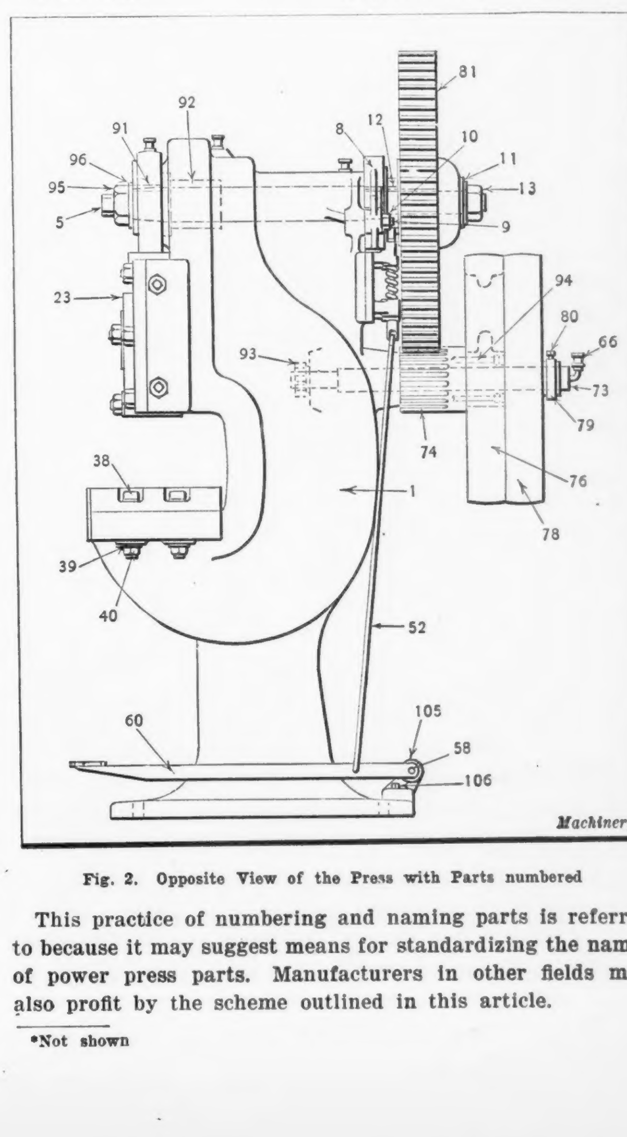


Fig. 2. Opposite View of the Press with Parts numbered

This practice of numbering and naming parts is referred to because it may suggest means for standardizing the names of power press parts. Manufacturers in other fields may also profit by the scheme outlined in this article.

*Not shown

GRINDING PRACTICE IN RAILROAD SHOPS

Surface grinding has proved an efficient method of machining various parts for locomotives and other railroad equipment. Castings and forgings are finished from the rough in many cases by this method even when a considerable amount of metal is required to be removed. Hard spots, scale, and sand do not slow up production an appreciable amount when the parts are finished by grinding, and this feature is a great advantage in machining certain parts of railway equipment. Very little has been published regarding the results obtained by the use of surface grinders in railroad shops, and the machining operations here described should therefore prove of general interest, as they are typical of the class of work being regularly performed in various shops by the use of Blanchard grinding machines.

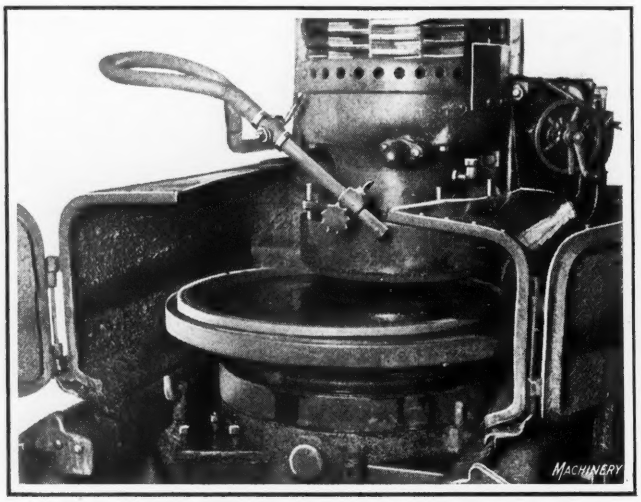


Fig. 1. Surface-grinding Sides of Locomotive Piston-ring

Grinding Piston-rings

Fig. 1 shows an 18-inch wheel surface grinder fitted for finish-grinding cast-iron piston-rings, which are 30¾ inches in diameter, and are held on a magnetic chuck 36 inches in diameter. After removing 0.009 inch of stock from one side, the ring is turned over on the chuck and the same amount removed from the other side; then to insure that the piece will be flat and parallel, it is turned once more and ground the second time on the first side. The thickness or distance between the parallel sides must be held to a limit of plus or minus 0.0005 inch. The average production on rings of this type ranging in size from 19 to 30¾ inches is 20 per hour (60 surfaces) or 3 minutes for each completely ground ring.

Rings larger than 30 inches in diameter can be centered on the chuck by stops, and ground satisfactorily without magnetizing the chuck. Small rings are, of course, grouped in multiple on the magnetic chuck. If rings of different diameters have the same thickness, they may be nested within each other. Small rings such as are used in air pumps are regularly finish-ground from the rough. For instance, air pump rings 9½ inches in diameter and ¼ inch thick are ground from the rough at the rate of 30 per hour in certain railroad shops. In this case 5/32 inch of stock is removed from each side, and the limit on the thickness of the rings is plus or minus 0.0005 inch. Six rings are chucked at one time for this operation.

Grinding Crankpin Washers and Link-block Plates

The machine illustrated in Fig. 2 is employed in grinding crankpin washers. Seven pieces are chucked at one time. These washers are 7¾ inches in diameter and must be ground on both sides, about 1/32 inch of stock being removed from each side. The sides are required to be parallel, and the limit allowed on the thickness is plus or minus 0.001 inch. The production rate is 60 finished pieces (120 surfaces) per hour.

Link-block plates are shown in Fig. 3 arranged on the magnetic chuck of the grinder. In the particular case illustrated, twenty-one plates are held in place on the magnetic chuck. It will be noted that each machine illustrated is provided with large-sized coolant pipes. When the machine is in operation, the doors of the water guards are, of course, closed.

Grinding Locomotive Links

In grinding locomotive links, two pieces are usually held on the magnetic chuck at one time. The production time recorded in one railroad shop on steel locomotive links 24 inches in length was 6 finished pieces (12 ground surfaces) per hour. In this case ⅛ inch of stock was removed from each side. The limits on the thickness of the links was plus or minus 0.006 inch. Links repaired or built up by welding are also easily machined to thickness on the surface grinder.

Grinding Grease Cellars, Main-rod Keys and Slide-valves

Cast-iron grease cellars are being machined regularly on surface grinders in various railroad shops. In one shop six

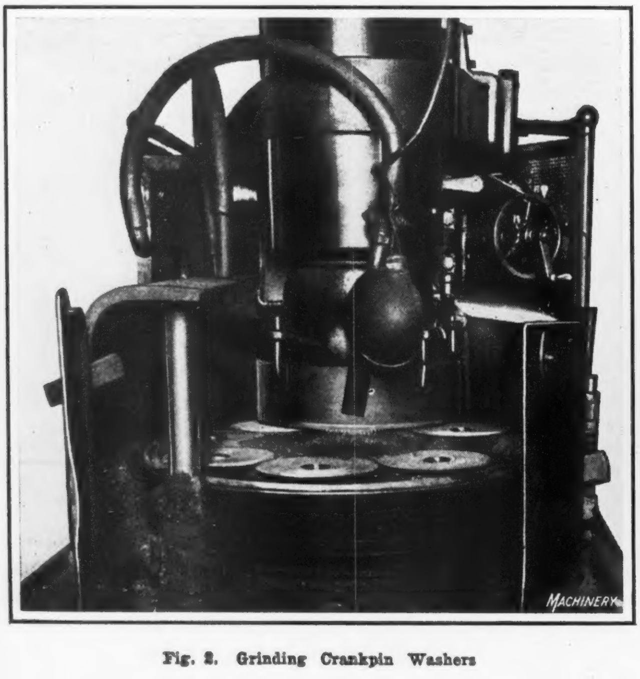


Fig. 2. Grinding Crankpin Washers

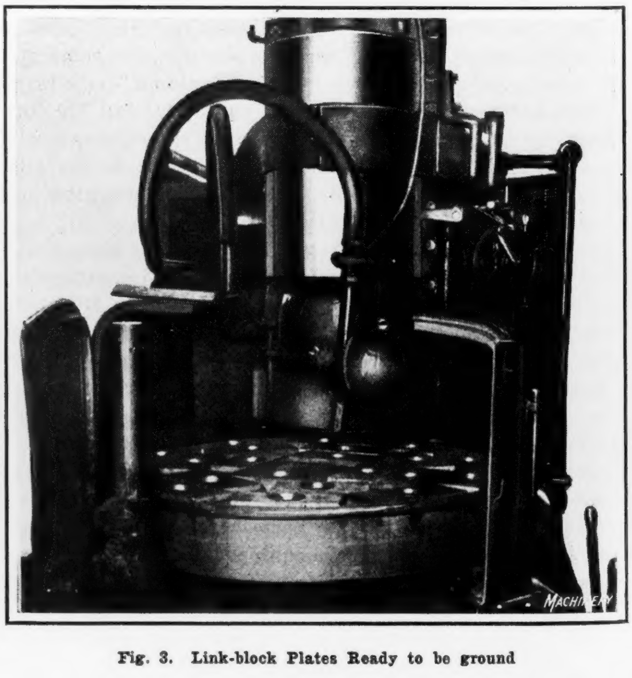


Fig. 3. Link-block Plates Ready to be ground

cellars, arranged radially on the magnetic chuck, are ground at one time. Approximately 1/8 inch of stock is removed from each side of the cellars, and the work is held to limits of plus or minus 0.008 inch. The production time for this job is 18 pieces (36 surfaces) per hour.

The production on steel main-rod keys 18 inches long, removing 1/16 inch of stock from each side, is 30 pieces (60 surfaces) per hour, in one shop. For this operation eight keys are chucked at one time on the magnetic chuck.

Worn slide-valves can be quickly trued up on the surface grinder. When thus trued up, the valves require no scraping. New slide-valves are machined at the rate of 6 pieces (12 surfaces) per hour in one plant. These cast-iron valves are 19 by 8½ inches, and require the removal of 1/8 inch of stock from each side.

* * *

CHART FOR DETERMINING SPEEDS AND FEEDS FOR INTERNAL GRINDING

By R. L. MORGAN, Greenfield Tap & Die Corporation, Greenfield, Mass.

Grinding machines of the reciprocating table type have in the past been limited in their productive capacity by comparatively low table speeds. Recently developed feeding mechanisms, however, have made it possible to successfully employ table speeds up to 50 feet per minute. The production-limiting factor of table feeds has thus been practically eliminated.

This increase in table speeds permits the use of broad-faced wheels in such a manner that their full face widths are used when cutting, whereas with the slower speeds previously available, only the leading edge or end of a grinding wheel did the cutting. With the increased speeds, however, the entire cutting surface of a broad-faced wheel can be presented to an entirely new surface upon the part being ground at each revolution of the work-carrying spindle. In other words, the grinding wheel follows a spiral path on the work and overlaps its path of advance just enough to cover and eliminate feed lines, thus making use of practically the entire cutting face of the grinding wheel. This practice results in increased production together with marked economy of wheel wear, because the entire wheel face, and not merely the front edge, is engaged in cutting.

The chart presented here has been prepared for use in determining the correct combination of table speed, wheel face width and work speed. The following examples will serve to make its use clear. It should be noted that the values given in the chart are the exact theoretical values and do not allow for overlap.

Table Travel in Feet per Minute

Let it be assumed that a wheel having a face 1½ inches in width is to be used in grinding work that is revolved at a speed of 350 revolutions per minute. The problem is to determine the table traverse speed in feet per minute that will permit the entire face of the abrasive wheel to be used in actual cutting. Referring to the accompanying chart, first locate the vertical line which represents a work speed of 350 revolutions per minute. Next, follow this vertical line upward until the point is reached where it intersects the slanting line representing the wheel face width of 1½ inches. From this point the horizontal line is followed to the left until the column giving the table speeds in feet per minute is reached. In this case it is found that the required table speed is 43 feet per minute.

Width of Grinding Wheel Face

As an example, assume that the grinding machine is set for a table traverse speed of 32 feet per minute and that the work-holding spindle revolves at a speed of 425 revolutions per minute. The problem is to find what width of face the grinding wheel should have to give maximum efficiency. In this problem, we first locate at the extreme left-hand side of the chart the point that represents a table speed of 32 feet per minute, and then follow the horizontal line from this point to its intersection with the vertical line that represents a work speed of 425 revolutions per minute. As the point at which the horizontal and vertical lines intersect is just above the line representing a wheel face width of 7/8 inch, it is evident that a wheel one inch wide should be used.

Speed of Work

In this example let it be assumed that a wheel having a face width of 3/4 inch is to be used in combination with a table speed of 25 feet per minute. The number of revolutions per minute at which the work should be revolved may be found as described in the following. In solving this problem it is first necessary to locate the point at which the horizontal line representing a table speed of 25 feet per minute inter-

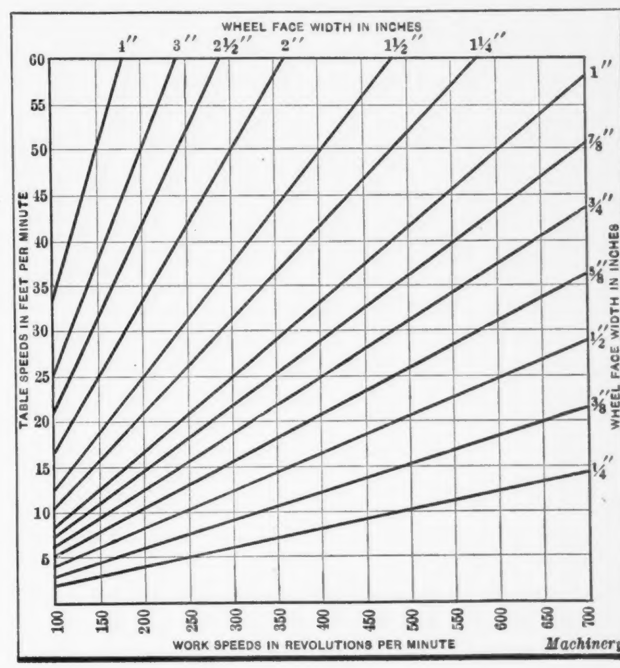


Chart for determining Efficient Combination of Feeds, Speeds and Wheel Widths for Internal Grinding (Values given in Chart do not allow for Overlap)

sects the diagonal line representing a wheel face width of 3/4 inch. From this point of intersection follow the vertical line downward to the column at the bottom of the chart. Opposite the end of this line we read the work speed of 400 revolutions per minute.

* * *

OFFICE MANAGERS' CONFERENCE

The fourth annual conference of the National Association of Office Managers will be held in Detroit, June 14 to 16. Among the papers that will be presented before the conference are: "Education the Basis of Office Management," by W. W. Kincaid, president of the Spirella Co., Niagara Falls; "Salary Standardization," by Harry A. Hopf of New York; "Office Machinery in the Reduction of Office Expenses," by H. A. Piper of E. I. du Pont de Nemours & Co., Wilmington, Del.; "Helping Our Schools to Help Industry," by Frank P. Hamon of the Goodrich Rubber Co., Akron, Ohio. There will also be round table discussions on such subjects as "Increasing Office Productivity by Bonuses and Ratings," "Application of Planning Principles to Office Work," "Office Manuals and Written Instructions," "Cutting Red Tape," "Mutual Service Work," and "Training." All interested in office administration are invited to attend the conference. Further information may be obtained from the secretary of the association, G. S. Childs, Alexander Hamilton Institute, 13 Astor Place, New York City.

The Machine-building Industries

THE industries in general show great activity. According to a report of the Federal Reserve Bank, "the industrial machine continues to forge ahead. Several 1920 production records were broken last month, which indicates pretty plainly the rate at which business is traveling. The 1920 records were established by reason of demands which were neglected during the war; the present high peaks have been reached without this urge, and with comparatively little assistance from foreign trade. The present progress of business is not tied down to a few particular lines; it is branching out in all directions. The iron and steel, building, and automotive industries are among the leaders."

On the other hand, we find a general attitude of watchfulness and caution among business and industrial leaders as the industrial machine shows a tendency to increase its speed. This attitude of caution constitutes one of the reassuring elements in the present situation; if adhered to, business will continue in its present state of activity for a longer period. While business conditions today have all the elements that make for stability and continued prosperity, conservative buying and carefully laid plans for the future are necessary if production, distribution, and consumption are to remain at a high level. The Department of Commerce has warned against inflation, and advises a careful study of the severe lessons of 1920.

Briefly stated, production in the basic industries rose during March to a level 8 per cent higher than the 1920 peak. The output of pig iron, steel and automobiles, and the consumption of cotton, exceeded all previous records; building operations showed a further large expansion; contracts made for residence construction during March were the highest on record; and railroad freight shipments are larger than at any corresponding time in the past.

The Machine Tool Industry

In the machine tool industry the rate of activity recorded in this review last month continues practically unchanged. Most manufacturers have sold off the stocks accumulated during the depression. The demand for lathes, planers, radial drills, horizontal boring machines and some lines of automatics is especially good. Special machines for the automobile field are still in demand, the saturation point for equipment in this industry evidently not yet having been reached. The railroads continue to be steady if not large buyers of the type of equipment best suited for repair shops, and the locomotive and railroad car building companies continue to add to their facilities. A fair demand for locomotive cranes is expected this year, although the general crane business is not as yet employed to more than about 50 per cent capacity.

It is difficult to say whether or not the demand for machine tools is in proper ratio to general business activity. Comparing the present production of the entire machine tool industry with that of 1914, it appears that the number of machines built is about twice that of nine years ago. On this basis of comparison one might say that the machine tool industry is rapidly approaching what ought to be termed a "normal" output; but the capacity of the machine tool plants is nearly double the present volume of business, and while some shops are occupied up to a hundred, or nearly a hundred, per cent, others are unable to obtain enough business to take care of as much as half their capacity. Buyers of machine tools are very careful in their purchases and are not taking chances on buying equipment likely to stand idle when the present business boom begins to recede. At the same time, many machine tool users are operating obsolete machinery that it would be true economy to replace by modern equipment.

There is a scarcity of skilled labor in the machine tool industry, and, as the country is producing to the limits of its labor supply, there are no prospects of any improvement in this condition. In some industries where labor has been paid at a lower rate, compared with others, wage increases have taken place.

The Toolmaking and Small Tool Industry

In the special tool and equipment field, business is very good and prices are now at a satisfactory level. Some tool shops could obtain more business than they have, but they too are limited by the available supply of toolmakers. Shops manufacturing small tools continue to handle an increased business, having gained month by month since last November. The increase in the number of orders is even more marked than the increase in the volume of sales, showing that activity in the metal-working field is becoming more and more general. The demand for production tools used in manufacturing in large quantities is becoming greater, indicating that other industries, besides the automobile industry, are producing on an increased manufacturing schedule. The demand for portable electric tools is equal to about two-thirds the capacity of the shops in that field.

The screw products shops are fully occupied and conditions in the gear-cutting field are generally good, although there are some complaints that keen competition has reduced prices to entirely too low a level for continued prosperity in this field.

The Iron and Steel Industry

A new pig iron production record has been set, the output now being at the rate of 44,000,000 tons a year. On May 1 there were 310 blast furnaces in action, an increase of 14 during April. The production of pig iron is now more than 10 per cent in excess of production during the record year 1916. The steel ingot production is also the highest ever recorded. The sales of fabricated structural steel reached a high record in March. Both steel and gray iron castings are in great demand, and most foundries are working to capacity. As a result, molding machines are selling unusually well in spite of the conservative attitude of the managers in the foundry field.

There does not appear to be any real scarcity of iron and steel, because the unprecedented production is ample to take care of actual needs; but prices for quick delivery are rising, because buyers outbid each other for immediate supply.

The Railroad Situation

The outlook for the railroads is very good. The traffic is mostly in excess of facilities, although a great deal of new equipment has been put into use. There is also more new equipment on order than ever before in the history of American railroads. From January 1 to April 1 over 1000 new locomotives and nearly 45,000 freight cars were placed in service, and on April 15, 1950 new locomotives and 117,000 freight cars were still on order. So far the railroads have contracted to spend $1,100,000,000 for equipment and improvements in 1923. In 1922, $440,000,000 was expended. Some railroad men believe that 1923 will be an exceptionally prosperous year in this field, and point to the fact that the freight carried during the first four months was larger in volume than ever before at this time of the year.

New Machinery and Tools

The Complete Monthly Record of New Metal-working Machinery

Continuous Boring and Turning Machine

A VERTICAL six-spindle boring and turning machine in which both the cutter-spindles and pieces of work rotate in a constant relation around the center of the machine, the spindles being fed downward at such a rate that each piece of work is finished when it reaches the loading position, has been recently built by the Davis & Thompson Co., 251 Reed St., Milwaukee, Wis. External and internal cuts may be taken simultaneously on the same piece. Power is transmitted to the main vertical driving shaft through a gear-box which provides various speeds to suit work of different dimensions. In addition there is a pick-off gear to provide for changing the speed of the rotating head to suit the operation. As the head revolves, the cutters of five spindles are always being fed downward along the piece of work beneath each spindle, but the sixth spindle is raised at the loading position in order to enable the operator to replace the finished part with another piece of work.

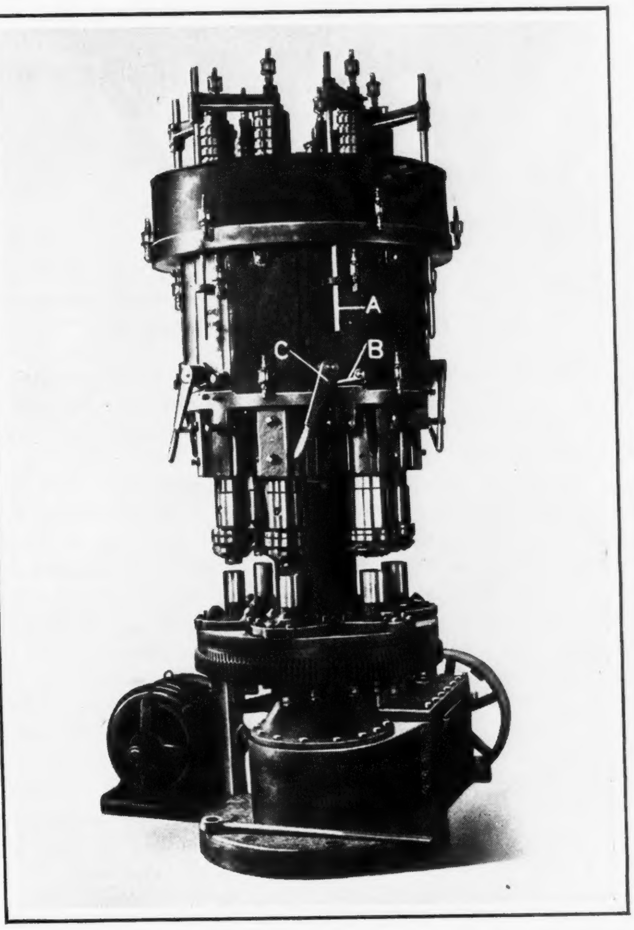


Fig. 1. Davis & Thompson Six-spindle Turning and Boring Machine

From Fig. 3, which shows the top of the machine with the cover removed, it will be seen that the central vertical shaft has a spur pinion at the upper end which meshes with a gear on each spindle. There is a left-hand thread cut on each spindle, and as its gear causes it to rotate, each spindle is fed downward at the desired rate by means of a nut until the work has been finished, and then fed upward rapidly. Differential gearing provides for turning the nut faster than the spindle to give this downward feeding movement.

When a spindle reaches the lowest point of its movement, trip-rod *A* (see Fig. 1), strikes catch *B* of lever *C*, permitting a spring located in the housing to disengage the clutch of the feed gear in the differential gearing of that particular spindle. This clutch then contacts with a surface and produces sufficient friction to keep the nut from turning. The continued rotation of the spindle results in its being raised to the starting position again, at which time the nut once more starts turning and overcomes the friction acting on the clutch, so that it is ready to feed the spindle downward when the operator throws in the feed after placing an unfinished piece of work in the chuck.

The tools that are provided on the machine for simultaneously boring and turning a piece are shown at *A* in Fig. 2. It will be seen that there is an inner holder *C* which is provided with a No. 5 Morse taper shank to fit the spindle socket. Screwed on the lower end of holder *C* there is a member *D* which carries six boring cutters. The turning tools are held in the lower end of holder *E* which screws on the threaded nose of the spindle, there being also six turning cutters. The tools in holder *D* are adjusted to suit the diameter of the work by screwing forward piece *F*, and those in holder *E* are similarly set by means of rings *G*. The spindles are 5 inches in diameter and their bearings are

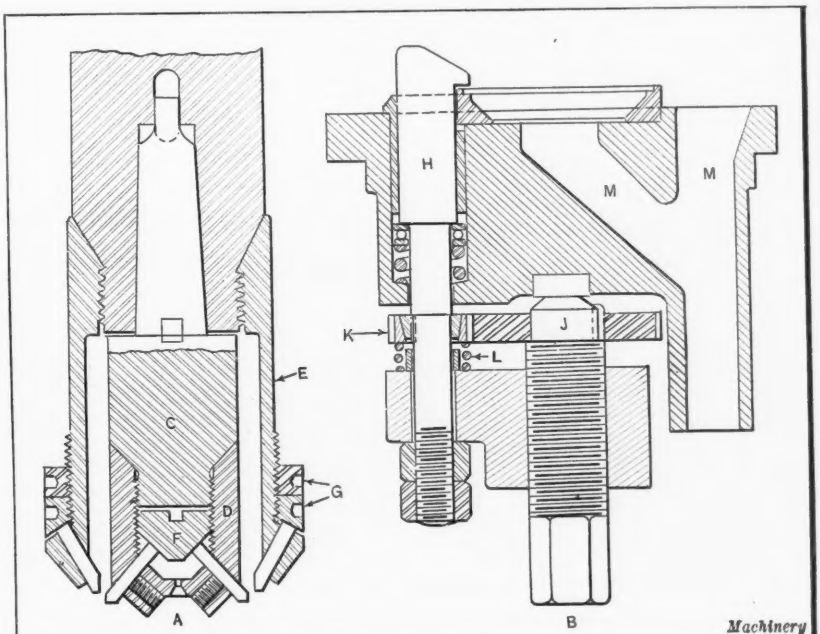


Fig. 2. (A) Sectional View of the Spindle Nose and Cutter-holding Members (B) Chuck-operating Mechanism

adjustable to insure rigidity in rotation. Large driving gears may be used on the spindles by arranging them as shown in Fig. 3.

Each of the six chucks on the machine illustrated is of the design shown at *B*, Fig. 2. There are three bolts *H* which have an eccentric head, these bolts being tightened or loosened by revolving the central screw *J* with a wrench applied to the lower end. There is a gear on this central screw that meshes with a pinion *K* mounted on a taper collar on each eccentric bolt. In revolving screw *J* to clamp a piece of work in the chuck, gear *K* will revolve and turn each bolt *H* until the bolt is tight against the work, after which gear *K* slips on its tapered seat. Until the head of the bolt contacts with the work, the pressure exerted by coil spring *L* is sufficient to make pinion *K* turn the bolt.

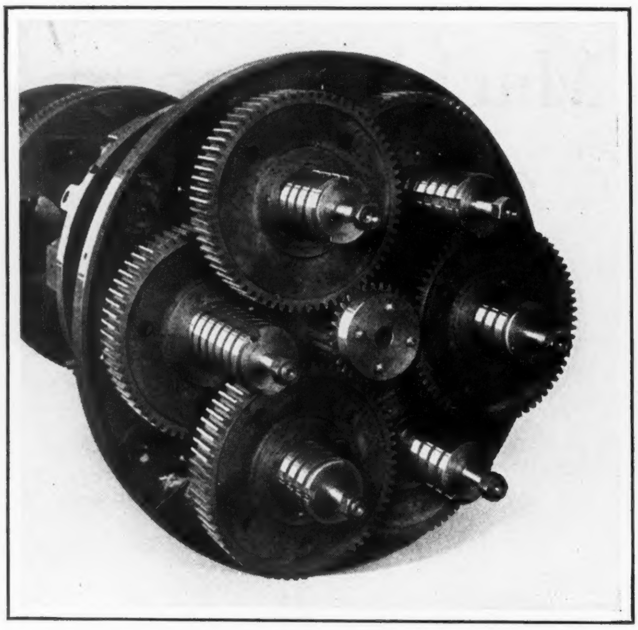


Fig. 3. Arrangement of the Spindle Driving Gears

It is obvious that this ingenious mechanism provides for clamping a piece in the chuck with one movement of central screw *J*. Chips falling from the boring and turning tools are disposed of by having them fall through passages *M*. The central screw is, of course, turned in the opposite direction to quickly release the work after it has been finished. Work up to 12 inches in diameter can be handled on this machine; in an operation consisting of turning and boring 6-inch diameter pots, 9 inches long, the production was three per minute. This machine weighs about 9500 pounds.

CLEVELAND BENDING ROLL, PUNCHING MACHINE AND SPACING TABLE

Three machines of interesting design which have been recently built by the Cleveland Punch & Shear Works Co., Cleveland, Ohio, are presented in the accompanying illustrations. The pyramid type bending roll shown in Fig. 1 measures 10 feet 2 inches between the housings; the multiple punching machine illustrated in Fig. 2 is mounted three on one bed for punching angle-irons up to 26 feet in length; and the hand spacing machine, of which a view of the operating unit is shown in Fig. 3, is intended for handling structural members such as I-beams, channel and angle-irons, and plates up to 40 feet in length.

The bending roll has a direct-connected motor drive, which is entirely self-contained and arranged for raising and lowering the top roll by power. This is accomplished through bevel gears, an elevating screw, a hinged yoke and a roll box at each end of the rolls. It is only a one-man job to disconnect and drop the hinged yoke. Two clutches are provided so that either end of the top roll may be raised or lowered independently of the other. An additional single clutch controls the rotation of the rolls. The lower rolls are 8 inches in diameter, one of which has three splines, while the other has two splines and a flanged groove. The upper roll is 11 inches in diameter. Special attention is called to the fact that none of the gears protrude into the foundation and hence no pit is required beneath the machine to receive them.

The mounting of three Style C punching machines on one bed, as shown in Fig. 2, is particularly desirable when holes are to be punched in a large number of angle-irons, as, for example, in the construction of oil derricks, roof trusses, and radio towers or other towers used for supporting water or storage tanks. Angle-irons used for these purposes, as a rule, have groups of holes punched at each end and at the center. The machine at the right-hand end of the bed is stationary, and the other two are adjustable by hand along the bed, to suit the locations of the holes to be punched. Each machine may be operated individually by depressing its treadle, or all three may be operated simultaneously by a treadle at each end.

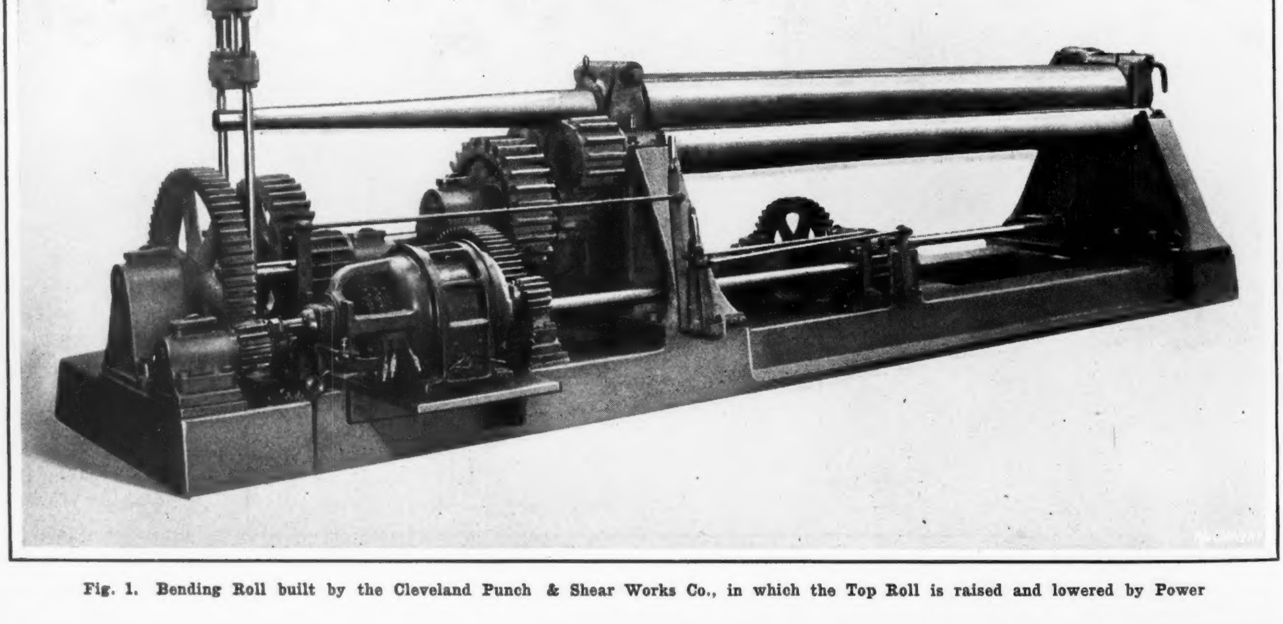


Fig. 1. Bending Roll built by the Cleveland Punch & Shear Works Co., in which the Top Roll is raised and lowered by Power

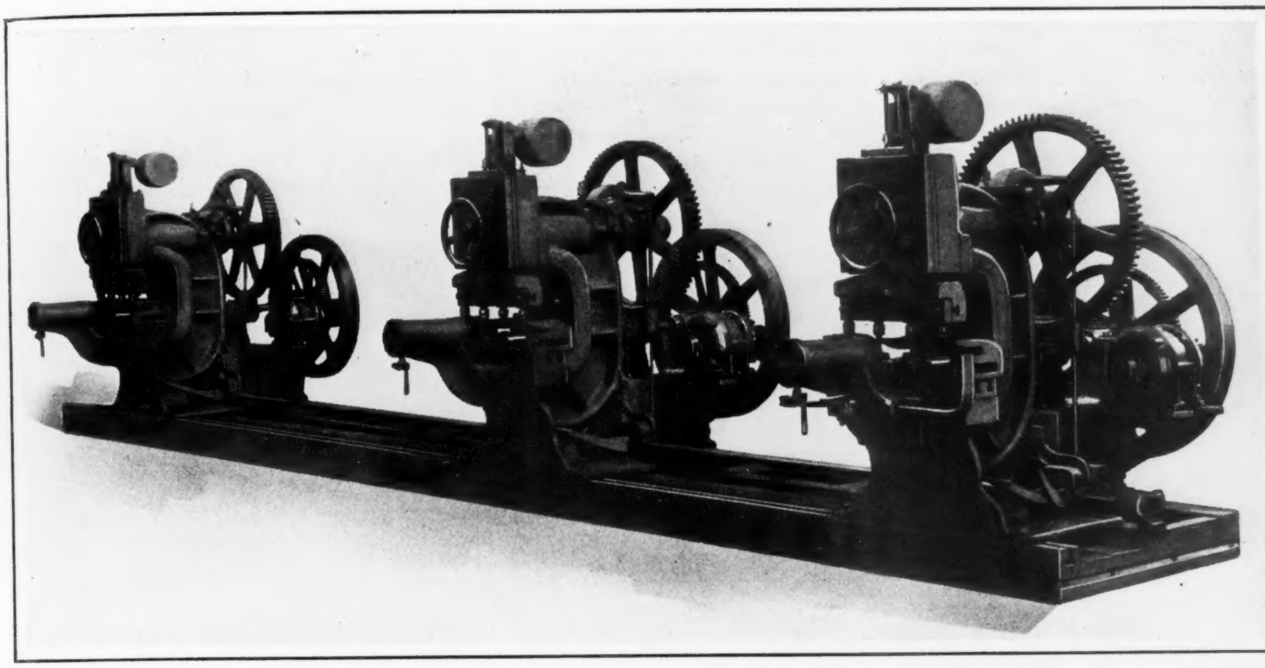


Fig. 2. Three Style C Punching Machines for producing Holes at the Ends and Middle of Angle-irons

Individually adjusted punch attachments are used, a minimum distance of 2 inches being permitted between attachments on each machine, and a maximum distance of 20 inches. Angle-irons may be punched in either leg without turning the angle-iron end for end. Air cylinders are employed to hold the angle-irons firmly in a straight position against adjustable gage-blocks, and supports are provided for the angle-irons. Each air cylinder may also be operated individually, or all of them simultaneously from the stationary machine. The machines illustrated have a capacity for angle-iron up to 6 by 6 by 5/16 inch, but a similar combination can be provided for larger or smaller material.

The hand spacing machine also referred to at the beginning of this article may be used with practically any architectural-jaw, open-gap single punching machine or with the I-beam type of machine. The work is held on the front side of the movable rail *A*, Fig. 3, and rests on rollers. This table will handle 24-inch I-beams with the material-supporting rolls in their lowest position. The table is of the open-side rail type and permits of loading and unloading directly from the front.

The movable rail *A* is guided by rolls *B* located on stationary tie-rails. End castings on the movable rail carry clamps for securing the work to the rail. One end casting may remain constantly in the same position, and the opposite one adjusted to suit the length of the work. The clamps may be released and thrown back so that the clamps and end castings may be returned over the fabricated material for reloading, it being thus unnecessary to unload before returning the rail to the reloading position.

The material-supporting rollers are raised and lowered individually by means of a crank, and the movable rail is propelled through a rack-and-pinion mechanism actuated by means of the 36-inch handwheel seen in Fig. 3. Stopping of the table may be accomplished by the use of adjustable steel stops, hard wood stops with pins, or notched wooden templets attached to the back of the movable rail. Then, by revolving the handwheel in the direction of the material travel, the stops are brought into contact with a stationary dog at the point where a hole is to be punched. The handwheel is next rotated slightly backward to escape the dog, and then rotated forward to move the material, allowing the dog to rise into the path of the succeeding stop. The backward movement of the handwheel does not move the material backward, as was true in former designs of spacing tables. A steel tape facilitates setting the adjustable stops.

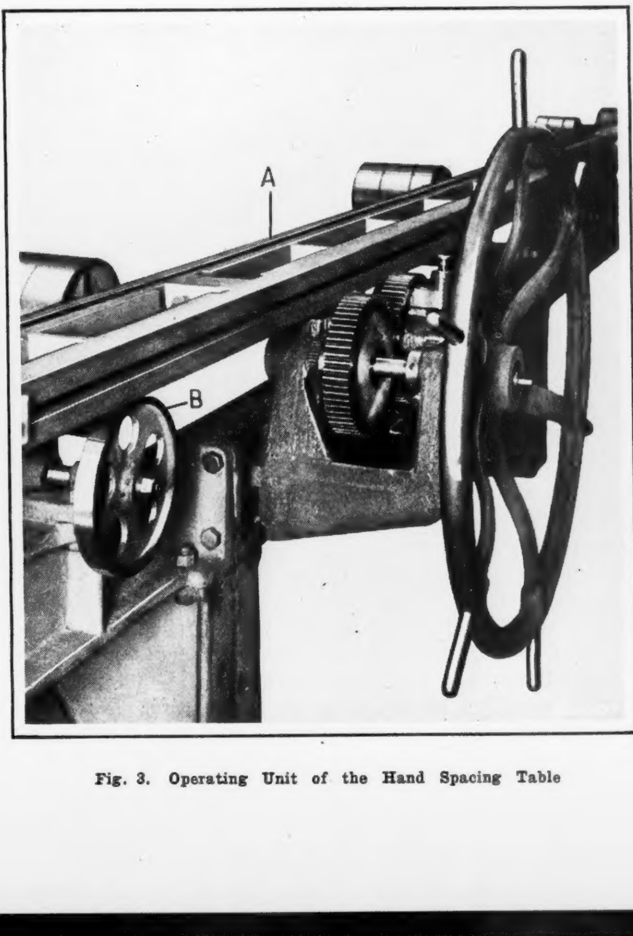


Fig. 3. Operating Unit of the Hand Spacing Table

BOOTH ELECTRIC MELTING FURNACE

Small quantities of metals can be conveniently melted for tool-room and similar purposes by employing a ladle-type electric furnace which is now being placed on the market by the Booth Electric Furnace Co., 411 N. Wells St., Chicago, Ill. This furnace has a capacity for melting 50 pounds of brass or copper, 20 pounds of iron or steel, or 12 pounds of aluminum at one time. In melting brass or aluminum, the metal is placed in the ladle and melted by drawing an arc between two 3/4-inch graphite electrodes which are arranged in approximately horizontal positions. However, in melting iron or steel, the electrodes are placed almost vertical to produce a fan-shaped arc directly on the charge. High-speed steel containing 20 per cent tungsten has also been melted in this furnace.

After a charge has reached the molten state, the electrode holders are withdrawn so that the ladle may be lifted from its supports for pouring. The ladle top is hinged

in order that it may be raised for charging. The arc remains steady during a melting, and should it cease, the resulting noise immediately attracts the attention of the attendant; however, little attention is said to be necessary. The lining of the ladle may be either acid or basic. This furnace may be operated on alternating or direct current. Its shipping weight is approximately 450 pounds.

NILES-BEMENT-POND RAILROAD SHOP MACHINES

A locomotive-frame slotting machine which will accommodate six 6-inch frames or four 8-inch frames at one time for simultaneously slotting, and a 48-inch car-wheel borer, have been recently built by the Niles-Bement-Pond Co., 111 Broadway, New York City. In the slotting machine, which is equipped with three heads as shown in Fig. 1, a reversing motor is used on each head to drive the head. The reversing motion in former designs was effected either by means of a crank and connecting-rod or by reversing pulleys and belts which transmitted power to a rack on the cutter-bar. In the new design the reversing motor drives through only one pair of gears, rotating a vertical screw which directly engages the cutter-bar.

These reversing motors are of 20-horsepower capacity, and have a 4 to 1 speed range. The cutting and return speeds are controlled independently, and any combination can be obtained within the range of the motor. The return-speed range limits are naturally much higher than those of the cutting speed. Two dials on the contactor panel are connected with the rheostats which govern these speeds, the desired cutting speed being set on one dial and the return speed on the other. The motor is reversed by automatic contactors governed by a pilot switch, which, in turn, is actuated by the tripping of adjustable dogs on the cutter-bar. These dogs are set to give the desired length and location of stroke, the maximum stroke being 38 inches.

Another novel feature of this machine is the feeding arrangements. Each head has its own motor for feeding and traversing the head along the bed and the saddle along the cross-rail. This motor, through gearing, drives nuts on fixed screws extending along each side of the bed, to furnish the longitudinal feed and traverse of the head. The same motor feeds and traverses the saddle along the cross-rail through another train of gears. The control and operation of both the feed and traverse is electrical. A dial is set to cause the motor to make one or more revolutions intermittently and obtain the desired feed; however, the throwing of a switch permits the motor to run continuously to furnish a fast traverse to either the head or saddle.

The machine may be built in one-, two-, and three-head styles, and with any length of bed. The bed of the machine illustrated is 60 feet long. Each head is self-contained and independent in every way, and comprises two principal members—the yoke and cross-rail. The latter can be swiveled in the horizontal plane for cutting angular surfaces. The opening in the yokes is 61 inches wide and 41 inches high.

The extension tool-bar is cylindrical in form, has a relief socket on the tool apron and an upper bearing in the cutter-bar. The tool-bar is revolved by means of worm-gearing. Handwheels are employed for setting the tools and for cutting fillets. Slotting at an angle too steep to be accomplished by swiveling the cross-rails is necessary at the ends of some locomotive frames. This requirement is met in the machine by combining the longitudinal and cross feeds for simultaneous action. Combinations of these feeds may be obtained for slotting at any angle up to 45 degrees.

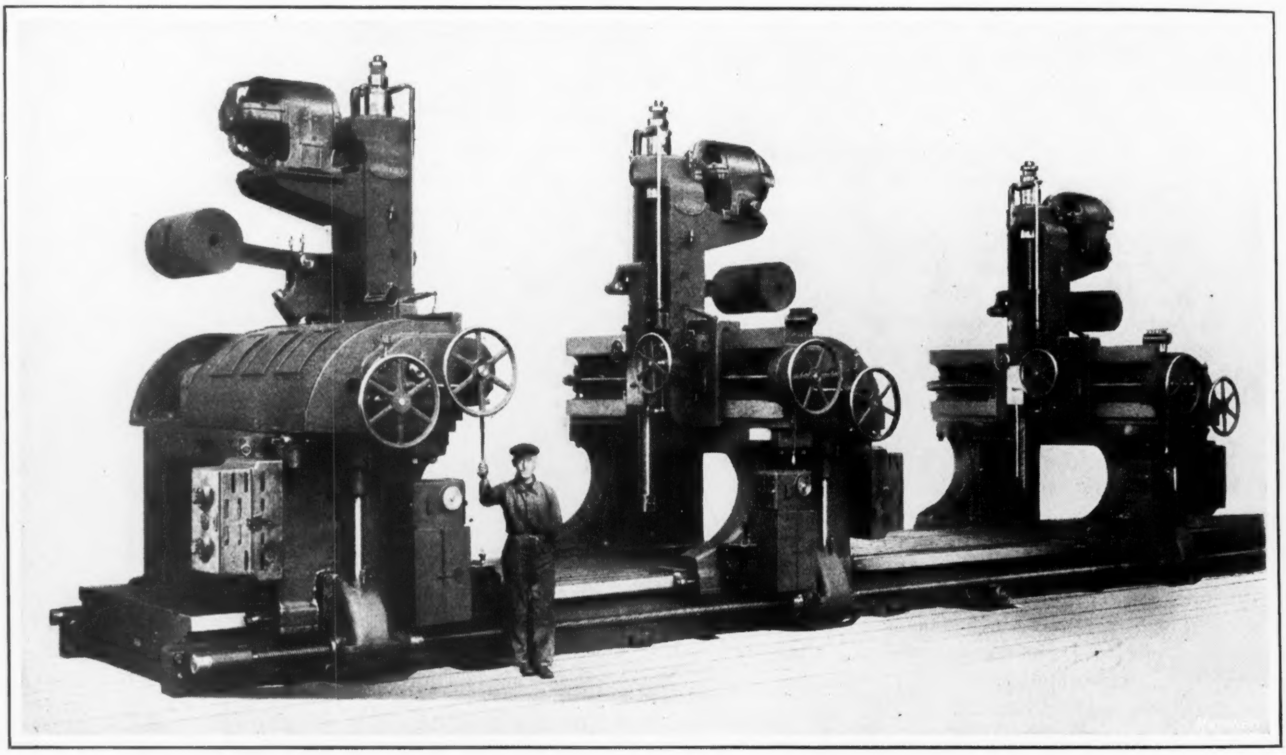


Fig. 1. Niles-Bement-Pond Locomotive-frame Slotting Machine equipped with Reversing Motors for driving Each Head

The car-wheel borer is of an improved design comprising several features which tend toward increased production and safety. The frame itself, as will be seen by referring to Fig. 2, is a one-piece casting of heavy construction which promotes output because of its rigidity and the ability to take heavy cuts. The pattern of the frame has been altered to give greater support to the hub-facing bar so as to make the heavy cuts possible.

An automatic self-centering chuck is an interesting and time-saving feature of the new machine. After the wheel to be bored has been swung into place on the table by means of the motor-driven crane supplied for that purpose, the motor is started at a slow speed. A mechanism in the table then causes the chuck jaws to move inward radially until they engage the wheel tread. When the job is firmly clamped, the table begins to rotate, and the driving force employed after the cutting operation begins, serves to further lock the wheel in the jaws. When the job is finished, the motor is reversed and the relative motion between

the driving gear and the table then serves to loosen the jaws and withdraw them toward the periphery of the table. The boring-bar counterweight operates down an incline on the back of the machine frame, and is so arranged that it is prevented from falling in the event of breakage of the supporting chain.

The machine is supplied with reversing motors for either direct or alternating current. The different table speeds are obtained by using a variable-speed motor in the case of direct current and a constant-speed slip-ring motor operating through a speed-change box where alternating current is used. No clutches are used in either case. Dynamic braking can be employed when a shop is equipped with direct current. Although the machine can also be furnished for driving by belt, an electric drive is recommended.

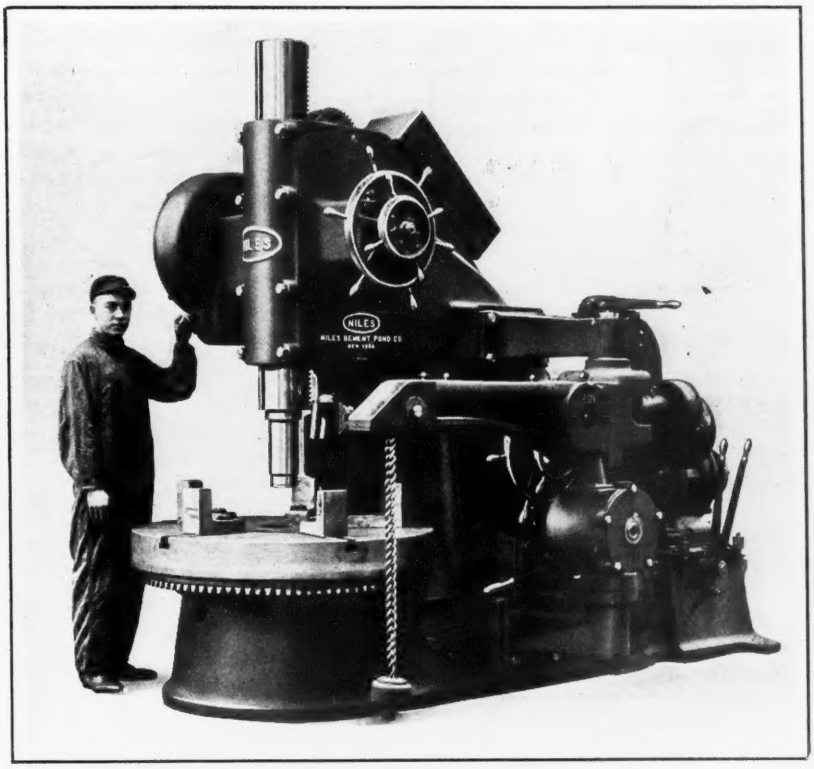


Fig. 2. Forty-eight-inch Car-wheel Borer with Hub-facing Attachment

AMERICAN AUTOMATICALLY OILED GEARED-HEAD LATHE

A recent development in lathe design is an automatically oiled twelve-speed geared-head machine made by the American Tool Works Co., Cincinnati, Ohio. The geared-head mechanism provides twelve mechanical spindle speeds in geometrical progression on all sizes of lathes up to and including the 36-inch "medium-pattern" machine. One of these lathes equipped with the new geared head is shown in Fig. 1. It is said that the 24-inch heavy-pattern lathe can use a 20-horsepower motor up to its full capacity; on the belt-driven machine of the same size the power is delivered to a 16-inch pulley by by a 6-inch double belt. All gears in the head are made of heat-treated manganese steel, and all speed change-gears are hardened. There are only three shafts, and so the gear centers can be located farther apart than in a four-shaft head of about the same dimensions, thus enabling gears of larger diameter to be employed. The entire mechanism runs in a bath of oil.

The head is under instant control through either of two levers, one located at the right-hand side of the apron and the other at the left-hand side of the head. These levers operate a friction clutch incorporated in the driving pulley, or in the driven gear of the motor train when the machine is motor driven. A band brake operates in unison with the friction clutch, being engaged when the friction is released. By means of the band brake, the spindle may be instantly stopped or allowed to drift, and may be securely locked in the stationary position.

In order to relieve the driving shaft from the belt pull, the pulley is bronze-bushed and mounted on a long steel sleeve of large diameter which takes the belt pull. This sleeve is also bronze-bushed and forms the journal for the driving shaft to which the pulley is keyed. An automatic oiling system reduces to a minimum the possibility of the pulley unit running dry. A feature of the head is the use of a gear-tooth clutch on the high-speed drive in place of the jaw clutch commonly used. The clutch consists of an external and an internal gear of the same diameter, pitch, and number of teeth. It is engaged and disengaged as easily as an ordinary transmission gear is slipped in and out of engagement. The clutch teeth are generated on a Fellows gear shaper, and rounded on the ends to facilitate engagement. Both members of the clutch are made of alloy steel, heat-treated and hardened.

An automatic oiling system for lubricating the geared head is one of the most important improvements incorporated in the machine. By means of a geared pump located in an accessible position inside the head, oil is pumped from a reservoir in the bottom of the head to a filtering and distributing tank in the head cover, from which every bearing in the head is lubricated. The construction will be understood by reference to Fig. 2 and the diagrammatic view of the oiling system in Fig. 3. After the fil-

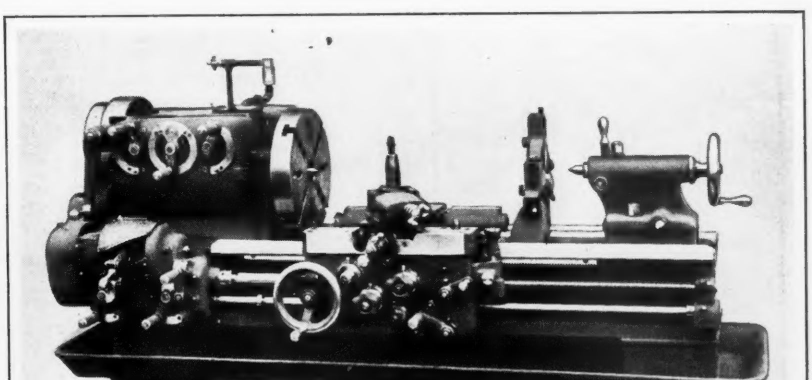


Fig. 1. American Twelve-speed Lathe equipped with an Automatically Oiled Geared Head

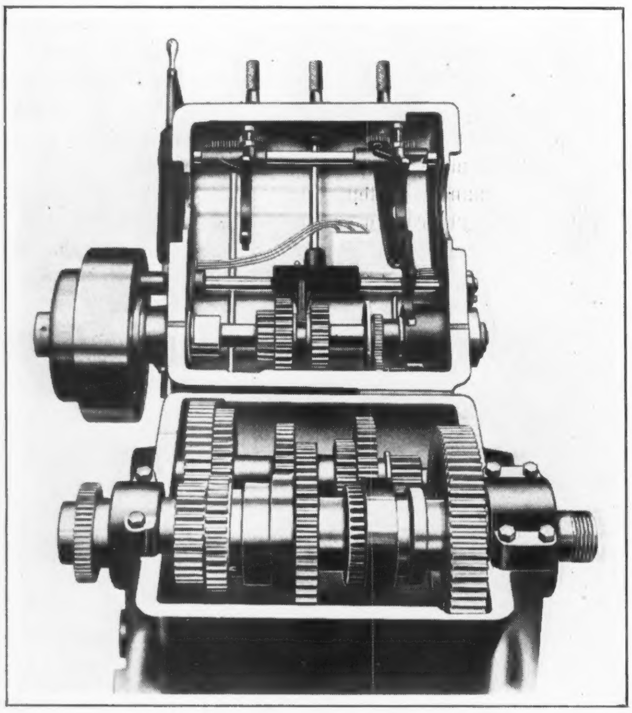


Fig. 2. View of the Geared Head with the Cover raised to show the Gears and Oiling Arrangement

tration of the oil, it gravitates to the various head bearings through pipes leading from the filtering tank. The pump supplies oil to the tank faster than the filter can take care of it and in much larger quantities than the bearings use; consequently, the surplus overflows on the gear teeth and keeps them constantly lubricated. All oil supplied to the bearings is thoroughly cleansed and strained by the filter to insure clean lubrication.

All heavy particles of foreign matter in the oil fall to the bottom of the reservoir in the head casting, and as the oil accumulates in this settling tank it overflows into a straining compartment from which it passes through a fine-mesh metal strainer into the pumping reservoir. From this point it is lifted by the pump into the filtering tank in the head cover, where it is filtered through a felt pad one-half inch thick before it reaches the distributing chamber from which it is led to the various bearings. This distributing chamber is divided into several compartments, each of which holds a supply of oil for one particular bearing. This arrangement insures that each bearing will have a copious supply of oil which cannot be diverted to any other bearing. A removable plug in the bottom of the settling tank provides a means for removing the sediment from the tank, and a signal glass in the supply line from the straining compartment to the filtering tank shows the operator how the oil-pump is working.

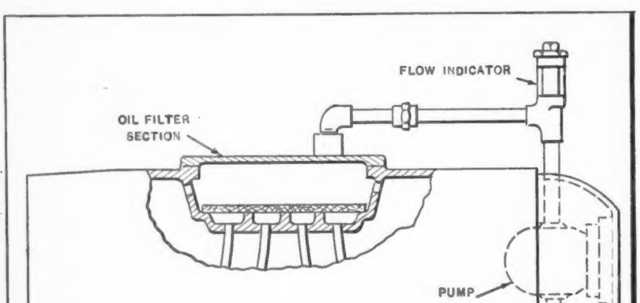


Fig. 3. Diagram of the Automatic System for oiling the Head Unit

LANDIS IMPROVED PIPE AND NIPPLE THREADING MACHINE

An improved design of pipe and nipple threading machine has been brought out by the Landis Machine Co., Waynesboro, Pa. It is equipped with a Landis internally tripped die-head, which automatically insures a uniform length of thread on nipples and eliminates the necessity of gaging each nipple by hand. Threading, reaming and chamfering operations can be performed on pipe and nipples. The machine is shown in Fig. 1, and the operating principle of the internally tripped die-head is illustrated in Fig. 2. This die-head is equipped with high-speed steel chasers and chamfering reamers.

Referring to Fig. 2, it will be seen that the knurled collar A and clamping rod C are integral. One end of rod C is threaded and screws into a tapped hole in the shank of reamer K. Knurled collar B is integral with tube D, the latter being threaded on one end to screw into spider E. Spider E has a square hole through it, and is tapped part of the way to fit tube D; this gives thread bearings on the four sides of the square hole. The remaining portion of the hole in the spider is left plain to afford a bearing for driver H. Driver H also has a square hole in the end to receive the shank of reamer K.

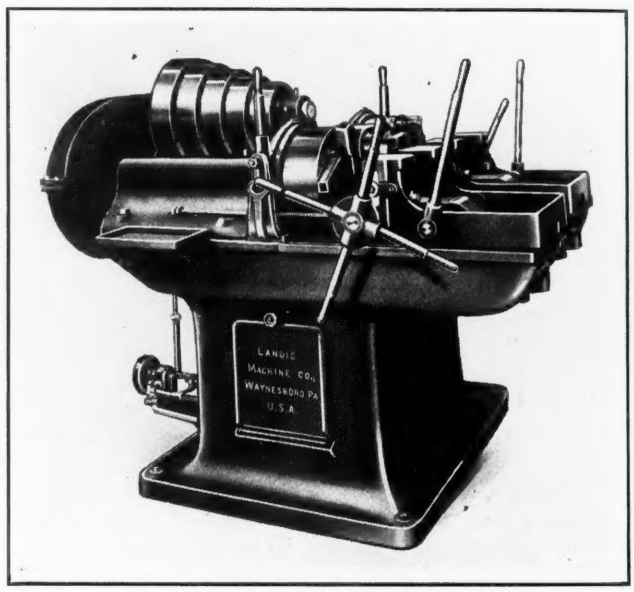


Fig. 1. Landis Pipe and Nipple Threading Machine with Internally Tripped Die-head

To set the reamer to the correct position, the knurled collar A is tightened by hand. This clamps together in one unit, tube D, driver H, and reamer K. Surface Y on the reamer has no cutting edge; therefore, as a nipple is being threaded and the end begins to bear on the reamer, parts D and H transmit pressure to spider E. Through the medium of pins F in the spider, rings G and I are carried backward for a distance X, or until pin M is disengaged from bushing L. The full opening movement is then completed by a spring in the adjusting ring. To adjust reamer K longitudinally, clamping rod C is unscrewed by turning knurled collar A to the left. Then collar B is turned to the right or the left for a forward or a backward adjustment, depending

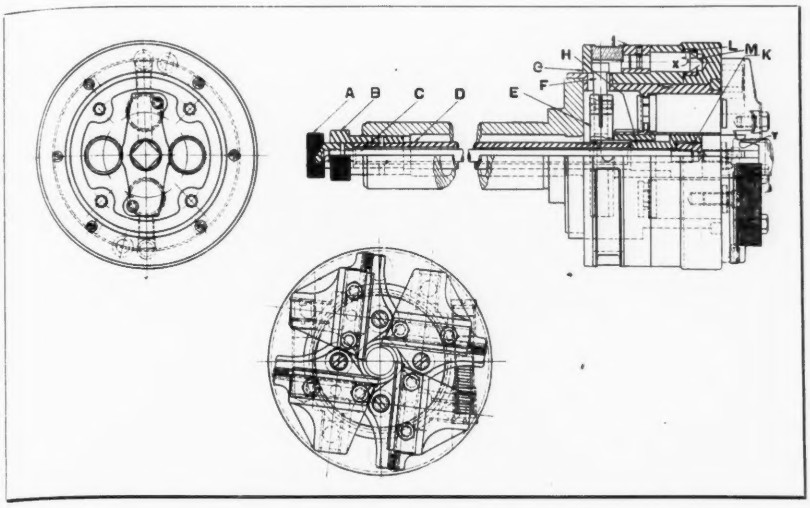


Fig. 2. Construction Details of the Landis Internally Tripped Die-head

on the length of thread to be cut. This machine is made in ½-, 1¼-, 2-, and 4-inch sizes, and in both single- and double-spindle types.

CLEVELAND UNIVERSAL DRILL JIG

A drill jig of novel design is being introduced to the trade by the Cleveland Universal Jig Co., 2005-2009 Oregon Ave., Cleveland, O. The jig is simple in construction, and is made in two types. Type A, which is shown in Fig. 1, arranged for drilling a hole in an automobile part, is designed primarily to take the place of the screw-bushing type of jig. It consists of a base and two columns in which there are two plungers holding a top plate, which is bored in line with a hole in the base, both holes receiving drill bushings. The plungers are operated up and down by means of racks and pinions in order to load and remove work. The pinion-shaft is actuated by the handle shown at the right, which is positively locked in any position on the sector by pressing the latch to pull down a wedge and cause a shoe to clamp the sector. The drill bushings can be made to suit any shape of work, whether round or odd.

Type B jig is shown in Fig. 2 in use for drilling a bell casting. This jig is designed to take the place of the leg-and-box type of jig. As with Type A, no clamps or screws need to be tightened in order to hold the work. It will be seen that this jig consists of a square base with a post fastened to each corner. To these posts a top plate is fastened, which is bored to receive the drill bushings. The same handle and rack-and-pinion movement are used as in the Type A jig, but instead of two plungers being pulled down, one plunger is pushed up to hold the work rigidly against the top plate while being drilled.

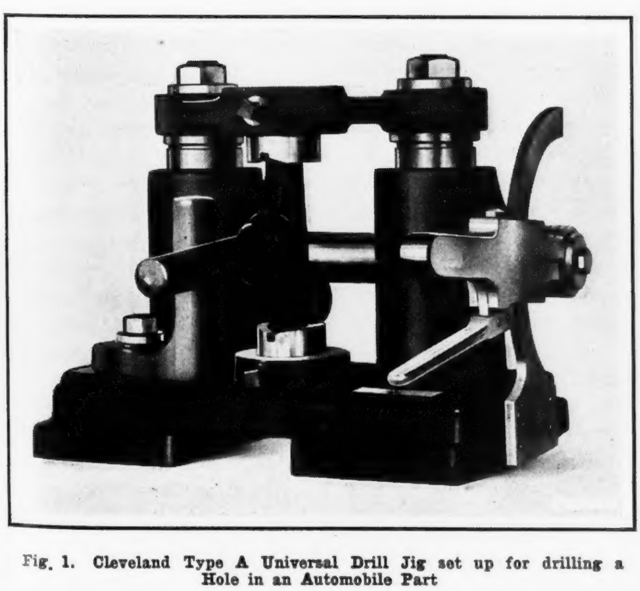


Fig. 1. Cleveland Type A Universal Drill Jig set up for drilling a Hole in an Automobile Part

The loading and unloading of the jig is simple, the work being put in place, and the handle pulled down so that the piece is held rigidly between the bushings, in the Type A jig, or against the top plate in the Type B jig, after which the handle latch is pressed to hold the work in that position. The handle latch is pushed down and the handle raised in order to remove the work.

Any number of different parts can be drilled by changing the bushings in the Type A jig, and the top plate in the Type B jig. This means a great saving in tool storage space and in the cost of making jigs for new parts, as it is only necessary to make new bushings or a new top plate when a different part is to be drilled. The greatest advantage claimed, however, is that a remarkable saving of drilling time can be effected, owing to the fact that both loading and unloading

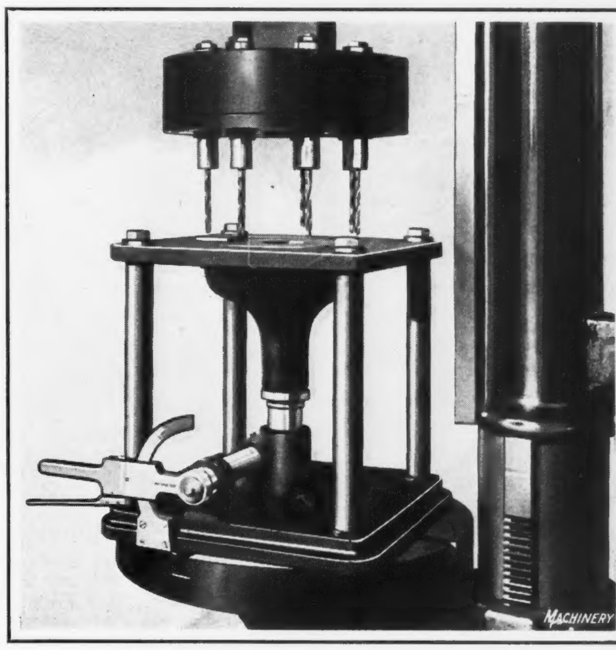


Fig. 2. Type B Universal Drill Jig set up for drilling the Bolt Holes in a Bell Casting

of the jig is done with the minimum number of motions. The loading time on practically all parts in both jigs is two seconds, and the unloading time is the same, making a total of four seconds.

HERBERT PENDULUM HARDNESS TESTER

An instrument of considerable interest has been brought out by Edward G. Herbert, Ltd., Chapel St., Levenshulme, Manchester, England, for testing the hardness of substances from lead to sapphires. The special application of this device in the machine-building field is for testing hardened parts. Briefly, the instrument consists of a frame which is supported on the work by a ruby or steel ball, and may be oscillated like a pendulum. There is a curved spirit level at the top of the frame and a scale that permits of observing accurately the distance traveled by the bubble in the level when the frame oscillates. The hardness of a metal may be determined in two ways; first, by observing the distance that the bubble moves from the zero graduation on the scale with the first oscillation of the pendulum, and second, by ascertaining the length of time elapsed while the

pendulum swings ten times. The construction and application of this device will be explained more fully in the following:

The ball on which the instrument rests is one millimeter in diameter and held in a chuck at the center of the device. Six adjustable weights are provided so that the center of gravity of the instrument may be made to coincide with the center of the ball. Directly above this ball there is a weight which is mounted on a screw, and by raising or lowering this weight, the center of gravity of the instrument can be brought to a predetermined distance above or below the center of the ball, graduations on the weight showing the displacement of the center of gravity in hundredths of a millimeter.

When the center of gravity is at the center of the ball and the ball rests on a hard level surface, the instrument will be in neutral equilibrium, and will remain in any position in which it may be placed, whether upright or tilted at an angle. If the center of gravity is above the center of the ball, the equilibrium may be unstable, in which case the instrument tends to "lie down" in some direction, but if the center of gravity is below the center of the ball, the equilibrium is stable. The instrument constitutes a pendulum which will oscillate about its central position, the time of oscillation being greater as the length of the pendulum (that is, the distance between the center of gravity and the center of the ball) is less. For standard tests, the length of the pendulum is one-tenth millimeter (0.0039 inch), and the time of a single swing on a very hard surface is ten seconds.

As previously mentioned, this pendulum hardness tester provides two entirely independent tests of hardness. Both these tests have a scale of hardness numbers from 0 to 100, but the hardness numbers of a given substance are not the same on the two scales. The two tests will generally show the same order of hardness for a given part, but sometimes a specimen will be shown harder or softer by one test than by the other. For most purposes, the time test is recommended, as it is quickly and easily made, gives uniform results, and does not require accurate leveling or extreme smoothness of surface; whereas the scale test requires accurate leveling of the surface to be tested (the instrument itself serves as a spirit level for this purpose) and freedom from scratches or other imperfections. The time test is a general test of hardness, and the scale test, in conjunction with the time test, is a further means of investigating the physical properties of materials.

In making a scale test, the device is tilted to the right until the bubble comes to zero on the scale, and then the instrument is placed in that position on a level surface and released. It will then swing in pendulum fashion with the oscillations gradually decreasing in amplitude owing to the expenditure of energy at the point of contact between the ball and the surface being tested. On plate glass the bubble travels from 0 to 97 on the scale; in the first oscillation, however, when placed on a less hard surface, such as hardened steel, the ball will indent the surface slightly and elongate this indentation as the pendulum swings. The energy consumed in thus displacing the metal is taken from the potential energy of the pendulum, as is shown by shortening its first swing.

The position of the bubble on the scale at the end of the first swing indicates the work done by the ball on the specimen, and is a measure of its hardness, as previously mentioned. In the case of a soft specimen, the indentation is relatively deep, and the pendulum comes to rest after a short swing; on lead it will not swing at all, so the bubble remains at zero. Typical scale-test readings with a steel ball are as follows: Glass, 97; very hard carbon steel, 93; hard carbon steel, 88; tempered high-speed steel, 75; annealed high-speed steel, 54; annealed carbon steel, 41; rolled brass, 14; cast brass, 4; and lead, 0.

In making a time test, the hardness number is the time in seconds consumed in making ten single swings. The pendulum is placed gently on the specimen with the bubble at or near 50 and caused to oscillate through a small arc. As the suspension is extremely delicate, it is preferable to set the pendulum swinging by touching it with a feather. The time is taken with a stop-watch provided with the equipment. In most cases it is sufficient to time a single or double swing, but on the softer metals and also for very accurate readings, the time of ten swings is taken. The time of oscillation is within limits independent of the amplitude. If it is caused to make a long swing on a soft metal, the instrument will merely settle down at the end of the swing in a new position, about which it will oscillate with short, rapid swings characteristic of the particular metal. Typical time-test readings with a steel ball are as follows: Glass, 100; very hard carbon steel, 75; hard carbon steel, 65; tempered high-speed steel, 52; annealed high-speed steel, 26; annealed carbon steel, 22; rolled brass, 15; cast brass, 11; and lead, 3.

Herbert Pendulum Hardness Tester which tests the Hardness of Metals by the Length or Time of Oscillations

If the pendulum is shortened to zero or the center of gravity of the instrument is placed above the center of the ball, the time of the swing will be greater than when the center of gravity is below the center of the ball, and the pendulum will be more sensitive to small differences in hardness; however, it requires more careful manipulation. Flat specimens are supported on a level table while being tested, and irregular or cylindrical objects are held in a universal ball vise provided with locking devices and leveling screws as shown in the accompanying illustration. A screw adjustment is provided for regulating the size of the bubble; the bubble tends to shrink in a warm atmosphere, but the instrument is otherwise unaffected by temperature. The pendulum is 12 inches long and will span flat surfaces up to 6 inches in width or circular objects up to 8 inches in diameter. The instrument is made in two weights, 2 and 4 kilograms, respectively, but the dimensions are identical in both. The lighter pendulum is supplied with either a ruby or a steel ball, and is suitable for testing the whole range of materials from lead to sapphires. The heavier pendulum is supplied with a steel ball only, and is intended for testing soft and hard materials up to and including hardened tool steels. This instrument is less affected by imperfections in the surfaces being tested than the lighter instrument, and is satisfactory for general shop testing.

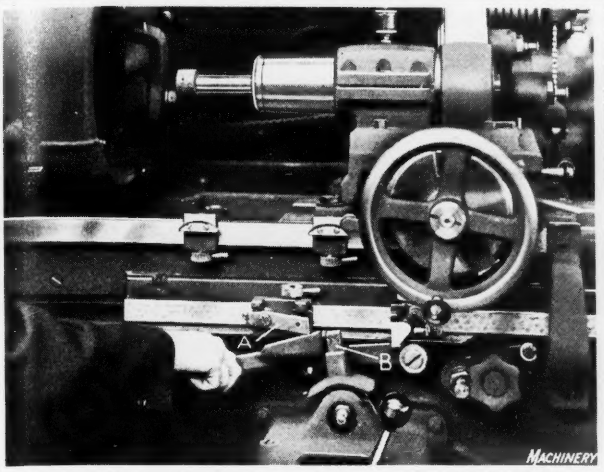


Fig. 1. Quick-return Mechanism for Table of Heald No. 72 Internal Grinding Machine

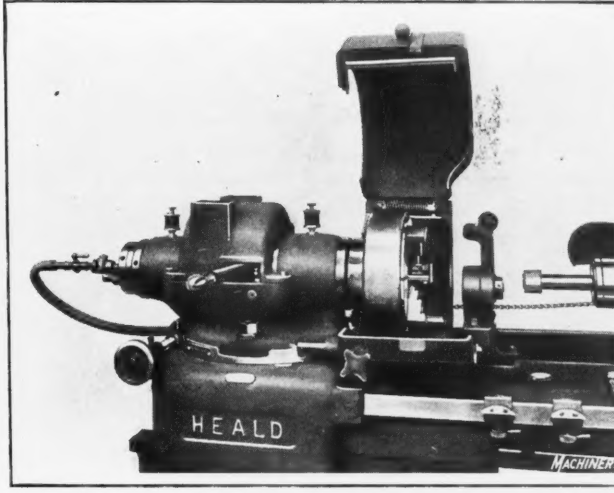


Fig. 2. Swinging Guard with which the Work-head of the Heald Grinder is now equipped

HEALD INTERNAL GRINDING MACHINE

A number of features have been added to the hydraulically driven No. 72 internal grinding machine built by the Heald Machine Co., 16 New Bond St., Worcester, Mass., which was described in March MACHINERY. The most important of the new features is a rapid return for the table. This rapid return is coupled with the hydraulic mechanism and is obtained as the wheel leaves the work on the out stroke, raising the left-hand dog *A*, Fig. 1, which causes the dog to pass over the reverse trip-lever *B*. A bevel surface on a bar under the dogs engages a roll which, in turn, actuates a plunger to operate a valve. This allows oil to go through a by-pass and furnish full power to move the table at top speed to the end of its stroke. Because of this quick return the operator may gage or remove the work with the loss of very little time. By simply throwing the reverse lever to the left the table again comes to the work at full speed, slows down to the working speed, and is then ready to grind a new part. Obviously, this rapid traverse effects a considerable increase in production.

Another new feature of the machine is the swinging work guard shown in Fig. 2. By simply releasing a spring catch, the guard swings up out of the way of its own accord and allows the operator plenty of room to gage or remove the work without inconveniencing him in any way. All piping on this machine is on the outside, which facilitates any necessary repairs to the line in case of leakage. There is a mechanism for opening and shutting off the water line simultaneously with starting and stopping the work. The lever on the front side of the work-head as seen in Fig. 2, which is used for starting and stopping the work, is connected through links at the back of the head to a valve in the water line.

The machine is also furnished with a swinging wheel-truing device, shown in Fig. 3 in the dressing position. Fig. 2 also shows this truing diamond, but in this illustration it is swung back out of the way. After the diamond has been once set and the wheel trued to grind a hole to the required size, it is only necessary to swing the truing diamond into position for subsequent dressings. The hole ground in the work need only be gaged occasionally to determine whether its size is being accurately maintained. When the wheel is worn slightly, the operator can move a dial one or two notches to bring the wheel into position for truing, and after truing, the wheel will be in the same relation to the work as when it was first trued, thus maintaining the correct size of hole.

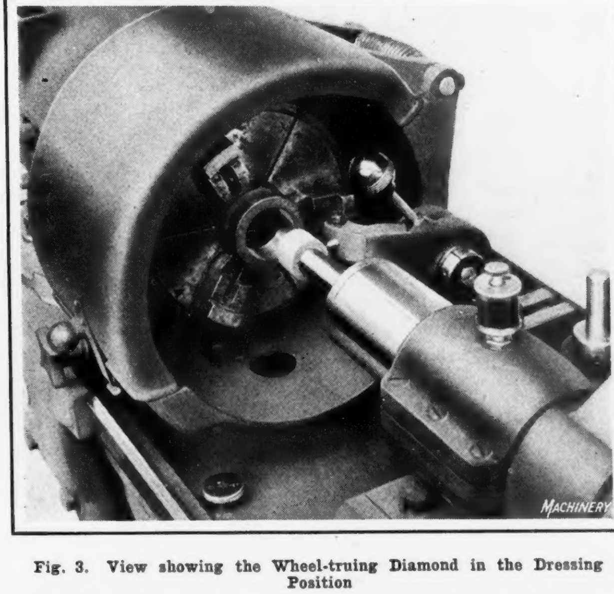


Fig. 3. View showing the Wheel-truing Diamond in the Dressing Position

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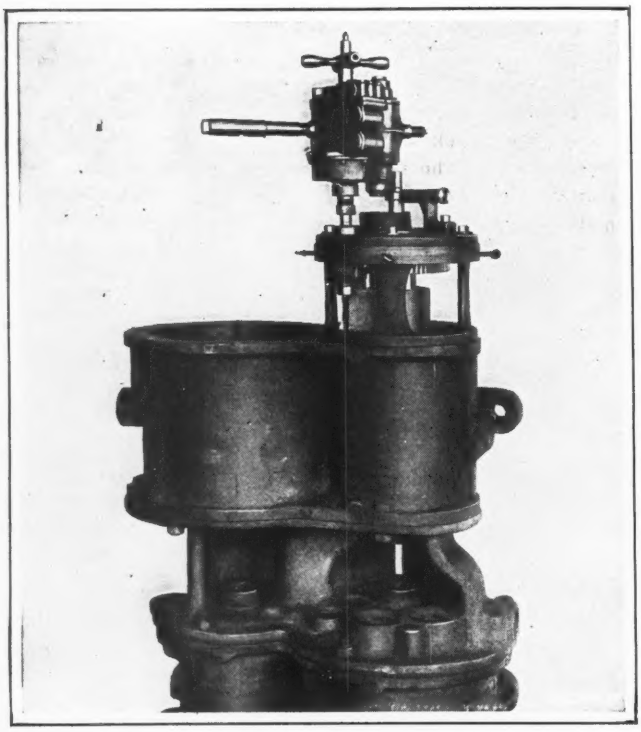
UNDERWOOD PORTABLE CYLINDER BORING EQUIPMENT

The latest development in the line of portable boring-bars made by the H. B. Underwood Corporation, 1015 Hamilton St., Philadelphia, Pa., is an improved equipment designed for reboring the cylinders of locomotive air compressors, either in the repair shop or while the compressor is in position on the locomotive, and for reboring pump cylinders in railroad shops and other industrial plants. This boring-bar is of a simple compact design that permits its use in close quarters. It is made with fewer parts than previous designs. The equipment consists essentially of a bearing plate carrying a boring-bar driving spindle and feed-screw mounted on a clamping ring, and a cutter-head.

Power for driving the equipment is derived from an air motor, the driving spindle being provided with a Morse taper shank to fit the motor. The spindle drives a pinion which meshes with a gear keyed to the boring-bar, affording a simple drive. Keyed to the feed-screw is a feed gear which meshes with a reverse gear journaled on a pin centered in the boring-bar. The reverse gear turns freely on this pin unless prevented by the engagement of a feed pawl, which holds the reverse gear stationary relative to the bar and causes the feed gear to revolve the feed-screw and advance the cutter-head into the work. The cutter-head is rapidly returned to the top of the cylinder by placing the motor on the shank of the reverse gear.

The application of the equipment is as follows: The pilot guide is screwed on the stuffing-box of the cylinder,



Underwood Portable Boring-bar Equipment for reboring the Cylinders of Pumps and Locomotive Air Compressors

the bar placed in the cylinder, and the clamping ring securely fastened to the top flange of the cylinder by studs and nuts, as shown in the illustration. Any inaccuracy in the position of the studs can be quickly corrected by means of four thumb-screws in order to set the bar in alignment. The tool is adjusted and held rigidly in the cutter-head by simply tightening a collar-screw and, if desired, may be as readily released when the cutter-head is at the lower end of the cylinder. In boring cylinders with this equipment, the use of calipers is entirely dispensed with, a gage furnished with each bar providing a simple method of setting the tool to the required position.

The time required for reboring both ends of a 9½-inch air pump with this equipment was as follows: Setting up on steam end, 7 minutes; reboring time, 16 minutes; removing equipment, 7 minutes; setting up on air cylinder, 8 minutes; reboring air cylinder, 15 minutes; removing equipment, 7 minutes; total time, 60 minutes. The tool is regularly made in sizes suitable for reboring cylinders and bushings of standard compressors, and may be adapted to other sizes by changing the cutter-heads. The weight of the equipment having a capacity for boring cylinders from 8½ to 11 inches in diameter and of 12-inch stroke (not including the weight of the motor) is about 140 pounds.

MOTOR DRIVE FOR HARRIS HOB SHARPENING MACHINES

The No. 815 automatic hob sharpening machine built by the Harris Engineering Co., Bridgeport, Conn., which was described in February, 1922, MACHINERY, is now being equipped with a new style of motor drive recently developed for the line of hob sharpening machines built by this company. This drive consists of two General Electric motors, one of which is mounted on the turntable which carries the wheel-head. Provision has been made for raising this motor to take up slack in the driving belt. The motor for driving the reverse table and indexing mechanisms and the spiral generating device is mounted on an integral bracket at the rear of the machine base, the necessary speed reduction being obtained through gears.

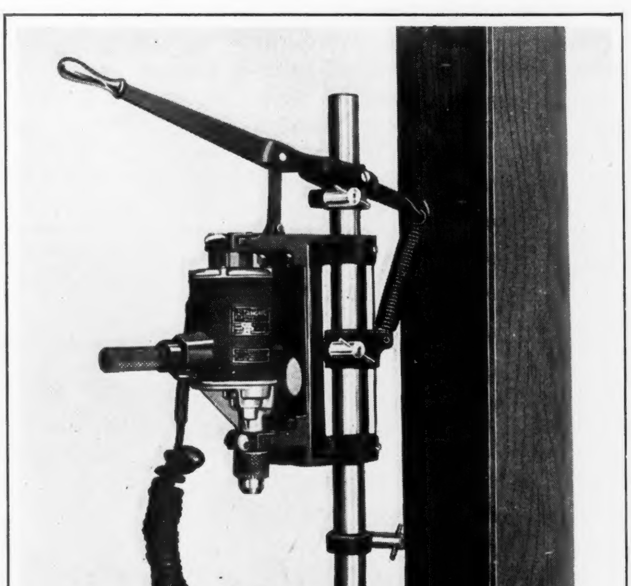
The upper motor is fastened by means of cap-screws extending through its feet to four large square-head adjusting screws. These screws are clamped rigidly in tapped holes in brackets by four lock-nuts. In adjusting the motor to take up belt slack, the four cap-screws and the lock-nuts are loosened slightly, and each of the square-head screws is turned an equal number of quarter turns, as indicated by the square head, until the belt is given sufficient tension. The lock-nuts and cap-screws are then tightened again to hold the motor rigidly. The motors are controlled by separate switch boxes of the safety type.

The vertical and lateral adjustments of the wheel-slide are effected through handwheels, which replace the ball-crank handles previously furnished. These wheels are of ample size to permit adjusting the slide closely. Each handwheel, through worm-gearing, operates a pinion that meshes with a rack on the movable member. The adjustment is very sensitive and easy to operate.

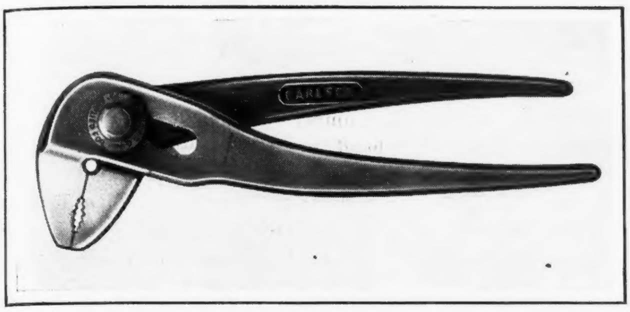
STANDARD PORTABLE ELECTRIC POST DRILL

The drill shown in the accompanying illustration is a recent design of the Standard Electric Tool Co., Cincinnati, Ohio. The principal advantage of this equipment is that it may be used as either a portable or a stationary tool, the drill being readily detached from the bracket for portable use. The company's hand and breast drills are used; this arrangement doubles the range of work of these tools.

The equipment can be mounted in any out of the way place, either on a wall or post. The bracket which holds the drill can be fitted at any point on the column, and raised and lowered by means of a clamping screw. The method of assembling the feed lever and coil spring gives an easy feed and a quick return. The table is slotted so that work can be clamped in place, and it can be swiveled about the column to any position that the post will allow. The drill bracket also swivels about the column, and both the table and the drill are adjustable vertically. The principal specifications are as follows: Over-all height, 36 inches; vertical adjustment of drill, 15½ inches; distance from column to center of table, 6⅛ inches; diameter of table, 9 inches; vertical travel of drill, 3⅛ inches; and net weight, 75 pounds.



Portable Electric Post Drill made by the Standard Electric Tool Co.



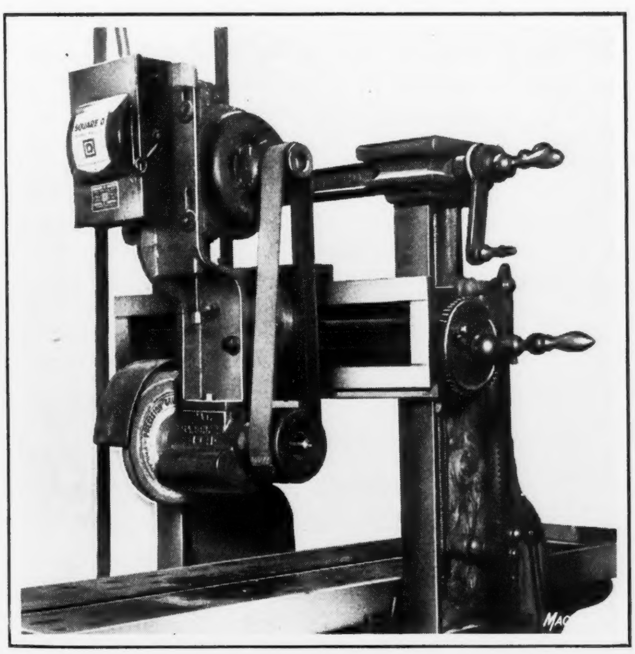
Carlson Plier which can be quickly adjusted to suit Different Sizes of Pipe

CARLSON PLIER

A plier that can be quickly adjusted to fit different sized pipes, bolts, nuts, caps, nipples, and similar parts, is now being manufactured by the Noble & Westbrook Mfg. Co., Hartford, Conn. The details of the construction may be seen in the accompanying illustration. This plier is especially useful for tightening or loosening parts located in corners or in close quarters. It is made from a drop-forging, machined, heat-treated, and given a charcoal and gun finish. The capacity is for parts up to 1 inch square or 1⅛ inches round, the length 7 inches, and the weight about ¾ pound. A patent is pending on the design of this plier.

HAWES PLANER GRINDING ATTACHMENT

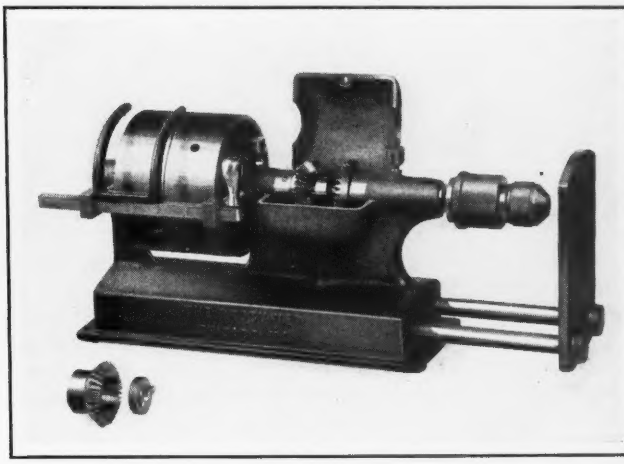
A grinding attachment intended for application on planers is being placed on the market by C. L. Hawes, Ashtabula, Ohio. This grinder will carry an emery wheel 12 inches in diameter and 2 inches thick. It is driven by a 1½-horsepower motor, an induction motor for 60-cycle three-phase current, running at 3600 revolutions per minute, being satisfactory. The wheel-shaft is 1 inch in diameter. The grinding head is equipped with Timken roller bearings mounted in dustproof housings. A patented oiling device insures proper lubrication from an oil reservoir which holds about a pint of oil and thus needs filling only about once a month. The motor has a 2-inch vertical adjustment for taking up stretch of the belt, and is held in position by means of an adjusting screw. The distance from the bottom of the bearing housing of the attachment to the top of the motor base is only 30½ inches.



Hawes Grinding Attachment for Application to Planers

PROCUNIER BENCH TAPPING MACHINE

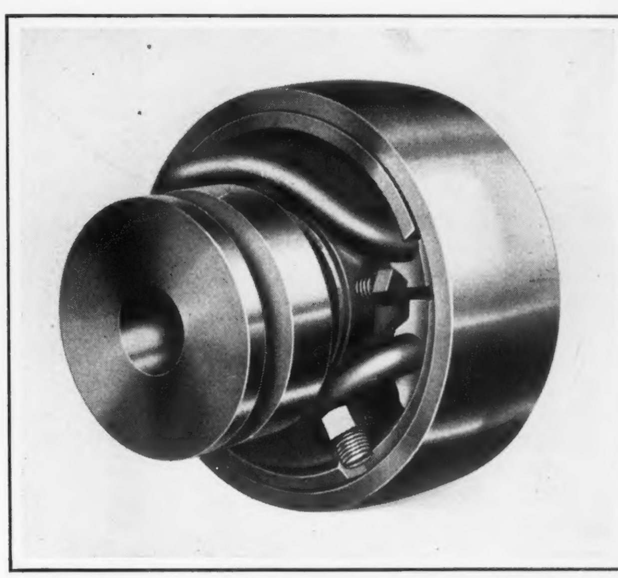
A bench tapping machine made by William L. Procunier, 18 S. Clinton St., Chicago, Ill., is shown in the accompanying illustration. This machine is equipped with a patented double-jaw chuck which grips and drives the tap by the square end, at the same time gripping and holding the tap true by the round shank. This tapping chuck may be furnished with or without a safety friction which slips the instant that a tap strikes the bottom of the hole, considerably facilitating tapping operations. In the lower right-hand corner of the illustration are shown two parts of the improved clutch used in this machine. In case these parts become worn out, it is a simple matter to replace them, disassembly of the machine not being necessary.



Procunier Tapping Machine of the Bench Type

CONWAY EXPANSION CLUTCH

For geared-head lathes and other single-pulley machines in which speed changes are obtained through gears, the Conway Clutch Co., 1962 W. 6th St., Cincinnati, Ohio, has brought out a line of expansion clutches which are said to develop a large amount of power for the space occupied. A feature of this clutch is the complete release obtainable, there being a friction band which springs entirely free from the drum because of its resiliency. This band is held tightly concentric with the shaft by means of a guide machined on the periphery of a carrier. There is a space of 0.010 inch between the friction band and the drum at all points when the band is released. The actuating parts are made from "Hytem" alloy steel and are hardened and toughened.



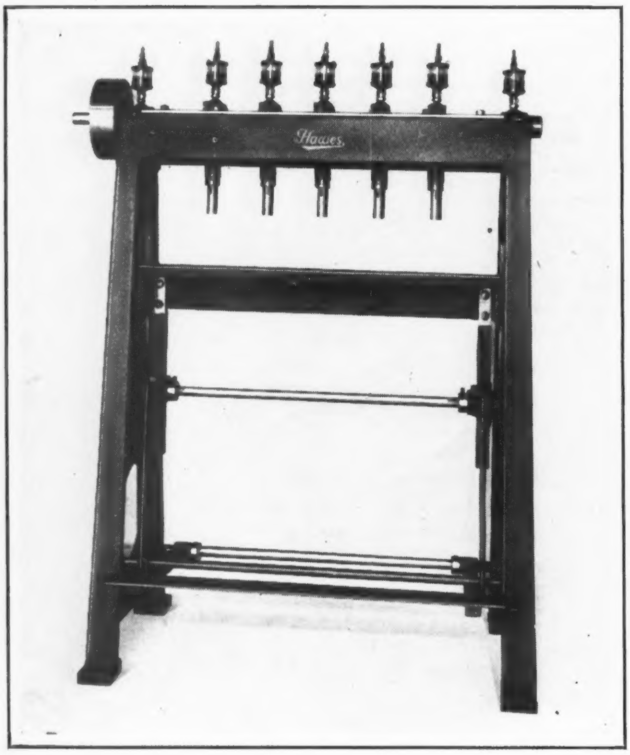
Conway Expansion Clutch for Geared-head Lathes and Other Single-pulley Machines

A large lever ratio is embodied in the clutch to reduce the power required for shifting, thus permitting the use of short levers. One screw is employed to adjust the entire clutch evenly. All parts are made to standard "Go" and "Not Go" gages so as to be interchangeable. In mounting this clutch on a shaft, oil is first applied on the shaft and then the collar is slid to the proper position and set. The loose member, consisting of the pulley, sleeve, and gear, is then slid against the collar, and after seeing that this unit revolves freely on the shaft, the clutch is forced into place over a key and held by a set-screw. End play of 1/64 inch is allowed between the inside face of the carrier and the loose member. The cone is then assembled on the shaft, after which the yoke or shifter fork is inserted. An oil chamber in the loose member should be filled each week with as much mineral oil as it will hold.

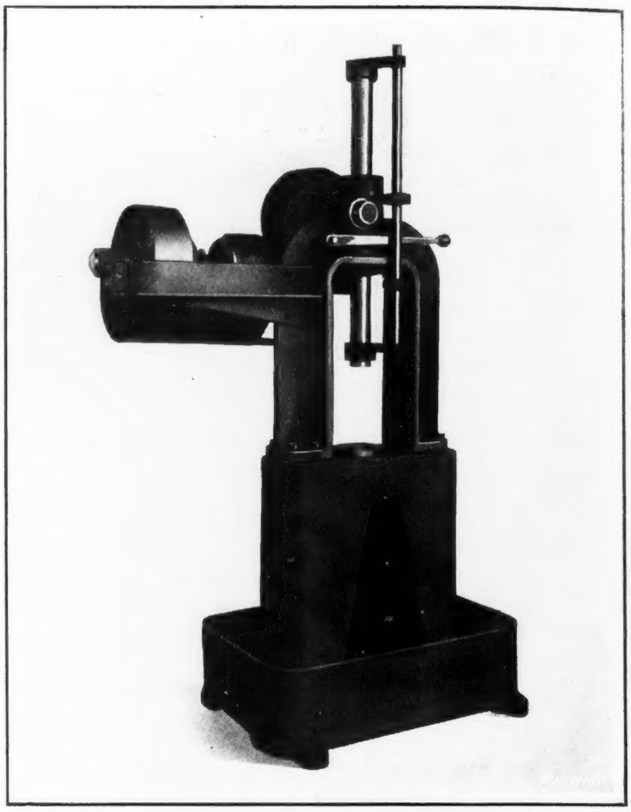
HAWES GANG DRILLING MACHINE

For a special variety of work in which holes are to be drilled in a straight line and the same or various distances apart, C. L. Hawes, Ashtabula, Ohio, has designed the gang drilling machine illustrated. Each drill spindle has an individual gear-case, all the gears in which are hardened and ground. The drill heads can be set any distance apart from 1¾ inches to within the range of the machine. All that is necessary to change the position of a head is to loosen the gib screws on top of the main frame which clamp the head in position, after which the head may be slid to the desired location. After the gibs have been retightened, there is no danger of the heads working endways out of position.

The illustration shows the machine fitted with a table operated by means of a foot-treadle; however, hand-operated and automatically fed tables may also be supplied, the type of table depending on the nature of the work to be handled. The machine may be run at a high speed for wood work. Each spindle has a ball thrust bearing and a No. 1 Morse taper socket. Some of the important dimensions are as follows: Height from floor to center of driving shaft, 52 inches; length of table inside of housings, 35 inches; and maximum height from top of table to nose of spindles, 9 inches. The approximate shipping weight is 1000 pounds.



Hawes Gang Drilling Machine



American Vertical Press for Push-broaching and Assembling Operations

AMERICAN BROACH AND ASSEMBLY PRESS

A vertical press having a pressure capacity of from six to eight tons and a maximum stroke of 18 inches has been built by the American Broach & Machine Co., Ann Arbor, Mich. The machine is intended for push-broaching operations and assembly work. It is equipped with a pair of friction clutches which gives it a flexible control. The drive is transmitted through a hardened steel worm and bronze worm-gear, and then through a hardened pinion to the steel ram. Automatic stops are provided, which are adjustable to suit the desired length of stroke. The table is bored 5 inches in diameter central with the ram to receive standard reducing bushings such as are used on horizontal broaching machines. The ram is 2½ inches in diameter, and has a hole in the lower end which is tapped 2 inches in diameter and 8 threads per inch. The space between the upright legs of the frame is 12 inches.

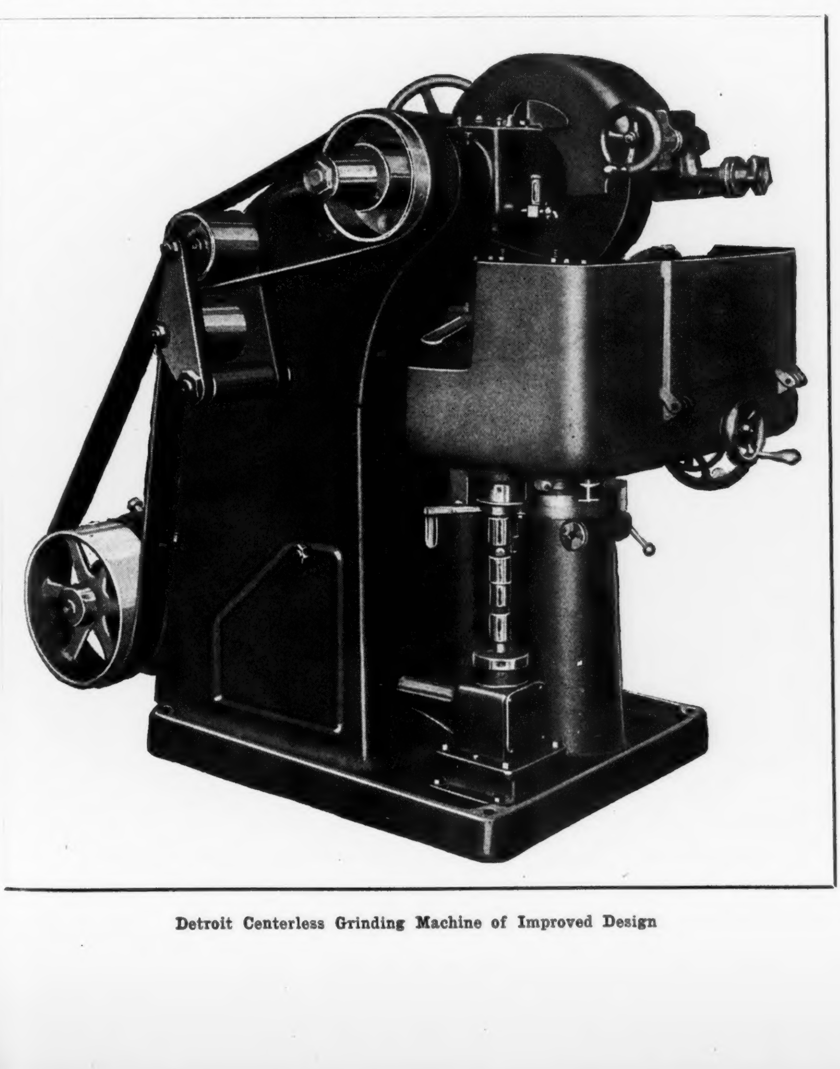
DETROIT CENTERLESS GRINDING MACHINE

An improved centerless grinding machine known as the No. 4-B has been brought out by the Detroit Machine Tool Co., 6525 St. Antoine St., Detroit, Mich., for grinding accurately, on a high-production basis, straight cylindrical parts such as piston-pins, gear and governor shafts, rubber and fiber rods, ball and roller bearing races, etc. The basic principle of the earlier No. 4 grinding machine described in April, 1921, MACHINERY is incorporated in the new machine; that is, the feed wheel is directly beneath the grinding wheel so that the work being ground rests on it and is rotated by it. This feed wheel is double the width of the grinding wheel, so that the work is rotating at the proper speed when it comes in contact with the grinding wheel. The feed wheel is mounted on a vertical column, about which it may be pivoted to vary the angle with the grinding wheel any amount up to 10 degrees, thus changing the speed of the work through the machine.

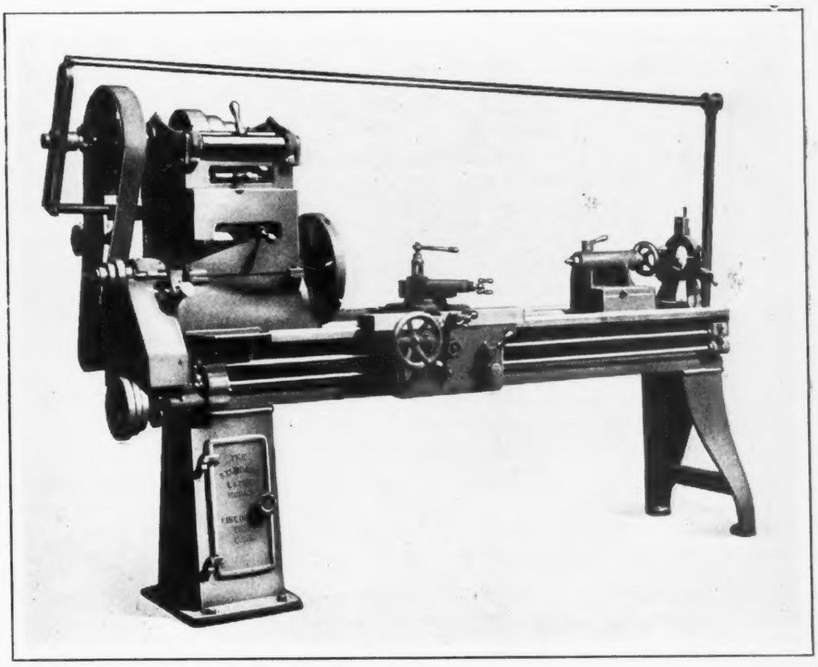
The diameter to which work is ground is controlled by means of a sensitive adjustment in the column of the lower unit. The adjustment is made through a large handwheel and a dial having graduations of ten-thousandths inch, spaced one-quarter inch apart, which, of course, permits minute adjustments. Two speeds for both the grinding and driving wheels are obtained through a change-gear box. The main driving pulley is 12 inches in diameter and runs at 750 revolutions per minute, giving grinding wheel speeds of 1080 and 1176 revolutions per minute and driving wheel speeds of 33 and 44 revolutions per minute. Other grinding wheel speeds may be obtained by the use of a special pulley.

The feed wheel is driven direct from the change-gear box through a pair of bevel gears and a vertical universal drive. This direct drive overcomes any tendency toward unsteady rotation of the lower wheel which might occur from the slipping of a belt. Backlash in the feed wheel is prevented by including a worm drive on the lower spindle, there being an ingenious arrangement to compensate for wear of the worm-gearing. The grinding wheel is driven by belt from the gear-box pulley, the belt running over a ball-bearing idler.

A feature of the grinding wheel drive is the method used for connecting the spindle to the ball-bearing spindle pulley. The pulley is mounted on a stud which is supported at the outer end by a cast-iron bracket. The inner side of the pulley carries a plate provided with a splined bore which engages with the splined end of the spindle so as to form a flexible coupling. This coupling transmits only a rotary motion to the spindle and thus overcomes the possibility of wear in the spindle bearing due to belt pull. The machine grinds work up to and including 4 inches in diameter.



Detroit Centerless Grinding Machine of Improved Design



Steptoe Engine Lathe equipped with Motor Drive

MOTOR DRIVE FOR STEPTOE LATHES

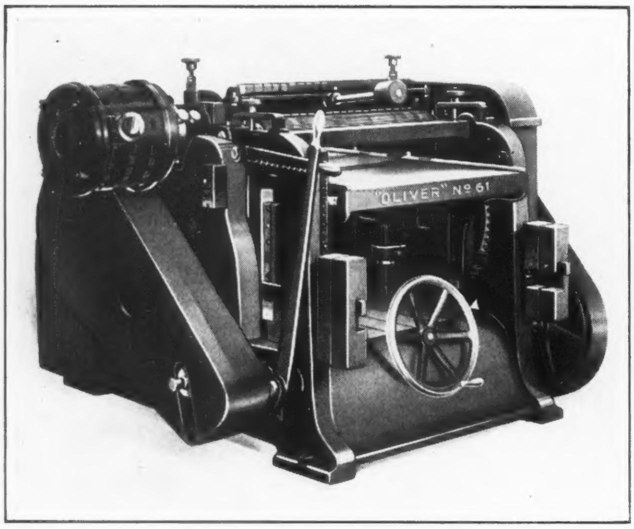
The line of engine lathes recently brought out by the John Steptoe Co., 2961 Colerain Ave., Cincinnati, Ohio, may now be equipped with a compact motor drive, as shown in the accompanying illustration. The arrangement is applicable to the 14-, 16-, 18-, and 20-inch machines. It can be readily attached to lathes in the field, as little machining is necessary, the principal work required being the drilling and tapping of a few bolt holes.

The countershaft unit is bolted directly over the lathe cone pulley, and is provided with a clutch gear so that the motor can be engaged and disengaged instantly. The cone pulley on the countershaft may be moved away from the lathe spindle to tighten the headstock belt while the proper tension of the belt from the motor to the countershaft is maintained by means of an idler pulley. The motor is placed directly behind the lathe in line with the bed. A constant-speed motor running at from 1100 to 1200 revolutions per minute is recommended.

OLIVER "MOTOR-ON-HEAD" SURFACERS

All wood surfacers or planers built by the Oliver Machinery Co., Grand Rapids, Mich., may now be equipped with a motor drive in which the rotor is mounted directly on the shaft of the cutting cylinder, and the stator is fastened to the frame of the machine. This drive eliminates all belting, as will be seen by referring to the accompanying illustration of the No. 61 improved single surfacer, which is intended primarily for pattern-shop use.

The machine is made in two widths, namely, 24 and 30 inches, and the bed may be lowered to plane material up to 8 inches thick. The standard feeds are 14, 18, 24, and 31 feet per minute. The cylinder is a crucible steel forging, and carries thin high-speed steel knives which are



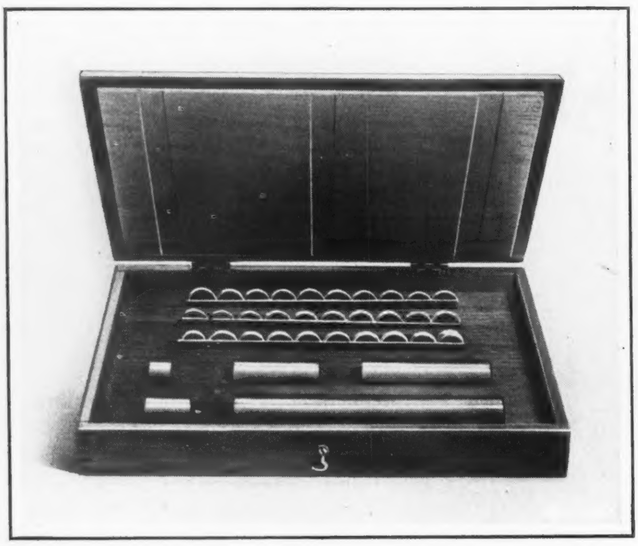
Oliver No. 61 Pattern-shop Single Surfacer with Improved Motor Drive

securely clamped against steel chip breakers having lips shaped to repel shavings and chips. The cylinder is ground to size all over and is provided with ball bearings. A back pressure bar follows the cylinder to supply a hold-down pressure on the lumber as it leaves the cutting member. Adjusting screws provide for regulating the pressure.

The Oliver Machinery Co. has also developed a No. 100 motor-driven knife-grinding attachment which may be operated from a lamp socket and which is designed for use on any of the surface planers or jointers built by the company. It grinds or "joints" the knives while they are held securely in place in their cutting position in the heads. Frequent whetting and joining is a comparatively simply matter, and so it is easy for the operator to keep the knives sharp.

VAN KEUREN "MICROGAGE" SET

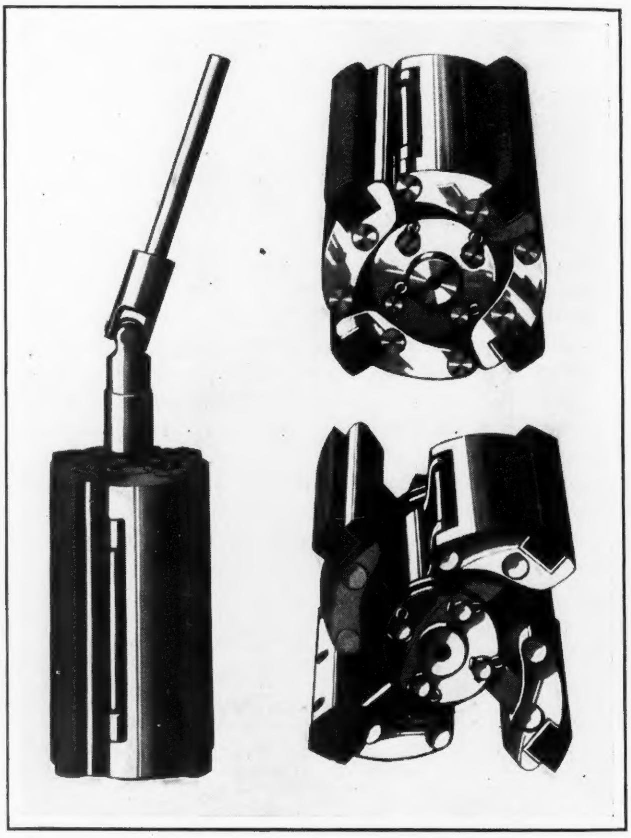
A complete set of "microgages" arranged in ten-thousandths of an inch, which is intended for checking micrometers and also for direct use on parts being machined, has been added to the line of measuring instruments manufactured by the Van Keuren Company, 362 Cambridge Street, Boston 34, Mass. Heretofore the "microgages" were only obtainable in small sets and in thousandths of an inch. The set illustrated contains thirty-five gages; the ten-thousandth series of ten gages ranges from 0.1000 to 0.1009 inch; the thousandth series of ten gages, from 0.101 to 0.110 inch; and the hundredth series of nine gages, from 0.120 to 0.200 inch. The remaining gages measure 0.300, 0.500, 1.000, 2.000, 3.000, and 6.000 inch, respectively. Standard gage-block sets are usually limited to 4-inch gage-blocks; with the 6-inch block the range of the set is 14 inches, and over 140,000 combinations are available. The 6-inch block may also be used for increasing the range of existing sets of gage-blocks.



Van Keuren "Microgage" Set for checking to Ten-thousandths of an Inch

"CENTRIMATIC" CYLINDER HONE

An automobile cylinder hone having self-adjusting, self-centering, and self-aligning features which are said to insure round and parallel cylinder bores, is now being placed on the market by the Automotive Maintenance Machinery Co., 549 W. Washington St., Chicago, Ill. As will be seen from the illustration, there are four honing stones held by wings which are hinged at both ends to the rigid arms of a central spider. Because of this construction the stones are always maintained parallel to each other and to the axis of the tool, no matter what their distance from the center of the hone. When the hone is rotated in a cylinder bore, the centrifugal force causes the wings to swing out and bring the stones in contact with the cylinder walls. An end view of a closed hone is shown in the upper right-hand corner of the illustration, while an expanded hone is shown in the lower right-hand corner. Abrasive stones which remove metal at a rapid rate without loading and which polish the walls in the same operation have been selected for the tool. No liquids or lapping compounds are required.



Self-adjusting, Self-centering, and Self-aligning Cylinder Hone made by the Automotive Maintenance Machinery Co.

The self-adjusting and self-aligning features are obtained by interconnecting the wings with links to a pair of disks. These connections coordinate the action of the four wings so that the slightest radial travel of one wing produces an equal travel of the other three. This linkage automatically keeps the stones equidistant from the center of the hone and insures that the cutting surfaces of the stones will rotate in a true circular path.

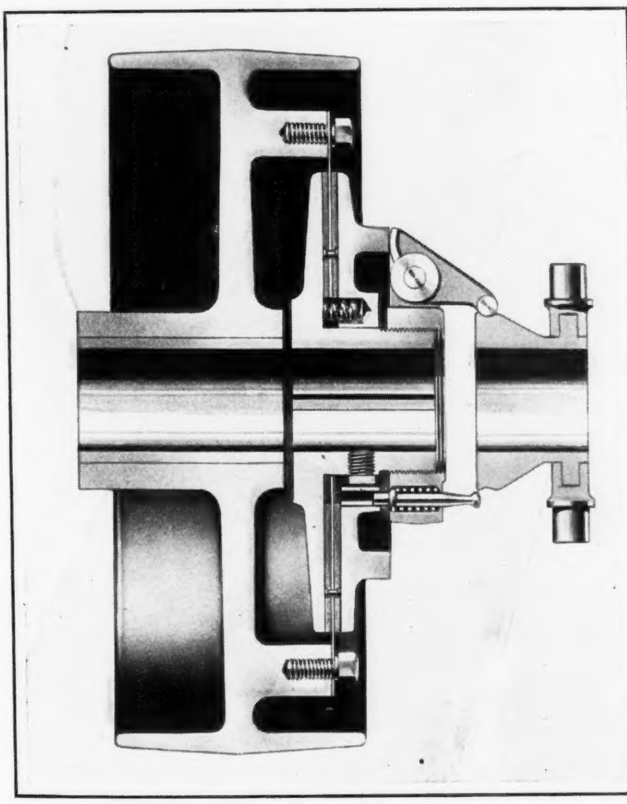
Each stone is held by a steel channel and hollow set-screws in such a way as to distribute the honing pressure along the entire length of the stone. This insures a minimum of stone breakage, and makes the replacing

of a stone a quick and simple matter. The centrifugal action resulting from the rotation of the hone within the cylinder, in addition to expanding the hone automatically to the correct diameter, also provides the proper cutting pressure. It is not necessary to caliper the hone diameter before beginning to work on a cylinder; the diameter of the bore needs to be watched only during the operation.

Extension blocks provide for increasing the diameter across the honing surfaces of the stones when cylinder bores from 4 to 5 inches in diameter are to be honed. It is recommended that the hone be driven at a speed of from 800 to 1100 revolutions per minute. The drive may be furnished by a portable electric drill, standard drilling machine, or multiple-spindle honing machine. In grinding a cylinder it is the practice first to enlarge the bore at its smallest diameter, and then slowly move the hone up and down until the bore in enlarged the full length to the desired diameter.

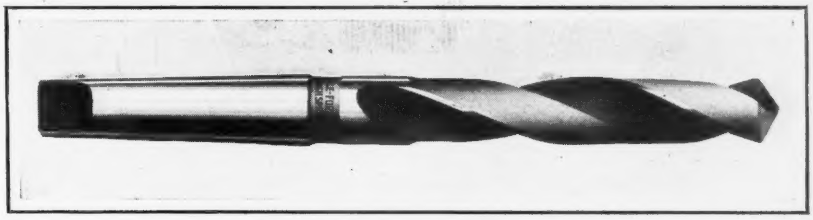
TWIN-DISK CLUTCHES

Two disks are brought into contact with the sides of a steel driving plate bolted directly to the flywheel or the driving pulley of a machine in a line of clutches which is being introduced to the trade by the Twin Disc Clutch Co., Racine, Wis. The construction will be readily understood by referring to the sectional view shown in the illustration. These clutches are intended for driving machines direct from main shafts without the necessity of using countershafts and the extra belting. When used with a pulley, either the pulley or clutch must be a floating fit on the



Twin-disk Cluch which transmits Power direct from the Flywheel or Driving Pulley

shaft to provide the lateral movement required for the free running clutch when it is disengaged. Twelve holes provide for adjusting the distance between the two disks; this is accomplished by pulling out the locking pin and turning the yoke until the pin drops into the next hole. This gives an adjustment of 0.005 inch between the disks. A grease cup must be fitted to the throw-out collar and filled frequently. As the clutch is of the dry-plate type, the disks should not be oiled. In one installation, a battery of eight lathes is driven from one jack-shaft by equipping each machine with one of these clutches, thus eliminating eight countershafts and cross belts.



"Cle-Forge" Drill which is hot-worked and milled to give it the Qualities of Both Forged and Milled Drills

"CLE-FORGE" DRILLS

High-speed drills have been made by two methods during the last few years. The first method involves a hot-working process to form the flutes, followed by a machining and a twisting process, or simply by a twisting process. In the second method the drill is milled from round bars. The Cleveland Twist Drill Co., Cleveland, Ohio, has for years manufactured both types of drills and has experimented, with a view to placing on the market one that would have the advantages possessed in part by the forged drill and in part by the milled drill. In spite of the additional toughness imparted to the drill by the first method, the second type of drill is the one manufactured and sold in the largest quantities. This is attributed to the fact that the webs of such drills are centrally located by the milling machine, whereas with the forged drill the web may not be central and it may be necessary to bring it in the correct position by a straightening or a flute grinding process or by resorting to both processes.

As a result of these experiments, the Cleveland Twist Drill Co. is now placing on the market high-speed drills made by the "Cle-Forge" process, these drills being hot-worked where necessary to impart toughness, and machined afterward in the same manner as a milled drill. In fact, the new drills cannot be distinguished from the milled product by mechanical inspection. In cutting quality and strength they are said to surpass the forged drills and their accuracy equals that of milled drills.

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MEETING OF THE TAYLOR SOCIETY

The Taylor Society, the purpose of which is to promote the science of administration and management, will hold a meeting at Hotel Onondaga, Syracuse, N. Y., June 7, 8, and 9, to which everyone interested is cordially invited. The program includes the presentation of the following papers: "Business Cycles and Unemployment," by Wilford I. King, Bureau of Economic Research, New York; "The Sales Machine: 1923 Model," by Harry R. Wellman, consultant on sales problems, professor of marketing at the Amos Tuck School, formerly sales manager of J. Walter Lowney Co.; and "The Planning Department as an Instrument of Executive Control," by Keppele Hall, supervisor of planning, the Joseph & Feiss Co., Cleveland. During the meeting opportunities will also be presented for the inspection of the planning department of the H. H. Franklin Mfg. Co., and of the planning department of the Corona Typewriter Co.

* * *

At the 1923 meeting of the National Foreign Trade Convention it was decided to hold the next annual meeting in Boston in the latter part of May, 1924. It is believed that a meeting held in New England will attract an unusually large number of delegates, and that next spring will see the largest foreign trade meeting ever held in the United States.

SPRING MEETING OF MECHANICAL ENGINEERS

The American Society of Mechanical Engineers held its annual spring meeting in Montreal, May 28 to 31. Among the many papers read on management, power developments, railroad engineering, port development, textile industries, and machine shop practice, the following are of particular interest in the field covered by MACHINERY: "Recent Developments in Balancing Machines," by Carl Richard Söderberg; "The Machine Tool and the Paper Industry," by G. E. Williamson; "Endurance Test Data and their Interpretation," by K. Heindlhofer and H. Sjövall; "Bending Stresses in Curved Tubes of Rectangular Cross-section," by S. Timoshenko; "A Practical Laboratory and Drawing-room Course in Industrial Engineering at Cornell University," by Myron A. Lee; and "Steel-car Construction at the Angus Shops of the Canadian Pacific Railway," by H. R. Naylor.

Recent Developments in Balancing Machines

In this paper the author describes a machine for balancing quickly and at low cost light rotating masses such as the rotors of small electric motors. The problems involved are discussed and the solution presented and illustrated. Four appendices are devoted to the discussion of (a) the correction of a general state of unbalance by two masses; (b) the requirements for constant period of a balancing machine with a movable fulcrum; (c) the analysis of the vibrating motion; and (d) the sensitiveness of the balancing machine.

An Improved Drafting-room Course

The paper by Professor Myron A. Lee shows how the early courses in industrial management have been widened in scope to include the engineering phases of the problems of manufacturing. This has been accomplished by supplementing the lecture courses with a practical laboratory and drafting-room course, in which the student has his own problem to work out in the design and operation of a modern industrial plant.

Methods of Building Steel Cars

In 1909 the Canadian Pacific Railway, to meet the increasing severity of modern traffic requirements, originated a box car having the entire frame built of steel. The production of such equipment in quantity necessitated the erection of an additional shop for the fabrication of the steel work, and the structure built embodied in its arrangement many novel features for the rapid handling of material to and from the machines, and during the various stages of assembly. Mr. Naylor's paper describes this shop completely, giving particulars regarding its lay-out, crane facilities, and machine equipment. The various machining operations and the jig method of car assembly, first put into practice at the Angus shops, are presented in detail, and the methods used in the final erection and finishing of cars are dealt with at some length.

* * *

EXAMINATIONS FOR PATENT EXAMINERS AND SHOP APPRENTICES

The United States Civil Service Commission, Washington, D. C., has announced an open competitive examination for assistant examiners to fill vacancies in the Patent Office. The examinations will be held in various parts of the country on June 20, 21, and 22. Full information and application blanks may be obtained from the United States Civil Service Commission, Washington, D. C., or from the secretary of the board of U. S. Civil Service Examiners at the post office or custom house in the larger cities. Applications will also be received before July 3 by the commission, for shop apprentices to fill vacancies in the Bureau of Standards, Washington, D. C. Full information and application blanks may be obtained by addressing the commission.

PERSONALS

P. R. HOOPES has opened an office as consulting mechanical engineer at 252 Asylum St., Hartford, Conn. He will specialize in the design of automatic and special machinery and in the development of inventions.

JOSEPH F. SAMPLE, formerly purchasing agent for the Budd Wheel Co., Philadelphia, Pa., is now affiliated with William L. Battersby in the selling organization of Battersby & Sample with office and display space at the Bourse, in the Machinery Exhibition and Sales Department, Philadelphia.

L. B. NOURIE, formerly connected with the Pittsburg office of Manning, Maxwell & Moore, is now associated with the Thomas Spacing Machine Co., and will have charge of sales in the Pittsburg territory of Thomas tools for bridge and structural shops, shipyards, steel car works, boiler shops, tank shops, railroad shops, etc.

HERMAN VOGES, JR., formerly president of the Webster & Perks Tool Co., Springfield, Ohio, with which company he was connected in various capacities for more than twenty-five years, has become affiliated with the Imperial Drop Forge Co., manufacturer of drop-forgings, Indianapolis, Ind., and is now secretary and general manager of this company.

JOHN P. BROWN, for the past three years engaged in rehabilitation work with the Philadelphia Power Plant Engineering School in the capacity of instructor in charge of the departments of machine shop practice and tool making, terminated his connection with that organization on May 31, and is now general manager of the Ace Hardware Mfg. Corporation, 1514 No. Park Ave., Philadelphia, Pa.

OSCAR ERICSSON, who since 1919 has represented several well-known American machine tool builders in the Scandinavian countries and eastern Europe, has terminated his arrangements with these firms on account of the extreme industrial depression in that part of Europe, and is now in the United States, having come here with a view to making connections with some machine building firm in a selling capacity.

HARRY COLLINSON has been appointed district sales manager of the Carborundum Co., in charge of the Milwaukee office and warehouse, succeeding J. H. JACKSON. Mr. Collinson was previously sales representative of the company in the province of Ontario, Canada. He will be succeeded in this position by C. E. BOWMAN, formerly connected with the sales department of Norman MacDonald, who has the agency for Carborundum products in Toronto.

ALLEN B. COFFMAN, formerly sales engineer for the Crouse-Hinds Co., has become manager of the Philadelphia district for the Reliance Electric & Engineering Co., 1056 Ivanhoe Rd., Cleveland, Ohio, manufacturer of electric motors. Previous to his association with the Crouse-Hinds Co., Mr. Coffman was assistant electrical engineer for the Philadelphia and Reading Railroad for approximately four years. He will be located in the Reliance Electric & Engineering Co.'s office in the Perry Bldg., 16th and Chestnut Sts., Philadelphia, Pa.

E. J. BRYANT has been placed in charge of the gage department of the Greenfield Tap & Die Corporation, Greenfield, Mass. Mr. Bryant has had over twenty years experience in the small tool industry—especially in the manufacture and use of gages; he has formerly been connected with the Taft-Peirce Mfg. Co., Woonsocket, R. I., and the Brown & Sharpe Mfg. Co., Providence, R. I. He is a member of the American Society of Mechanical Engineers and also a member of that society's committee on plain limit gages for general engineering work.

F. ARCHER THOMPSON will represent the Bullard Machine Tool Co., of Bridgeport, Conn., in the Detroit territory. He will serve the company in both a sales and engineering capacity. Mr. Thompson is located in the Majestic Bldg.. with the Motch & Merryweather Machinery Co., the official representative of the Bullard Machine Tool Co. in Detroit. He has been connected with the Bullard company for several years at the Bridgeport plant, in the manufacturing and service departments, and previous to his present appointment held the position of chief of the equipment department.

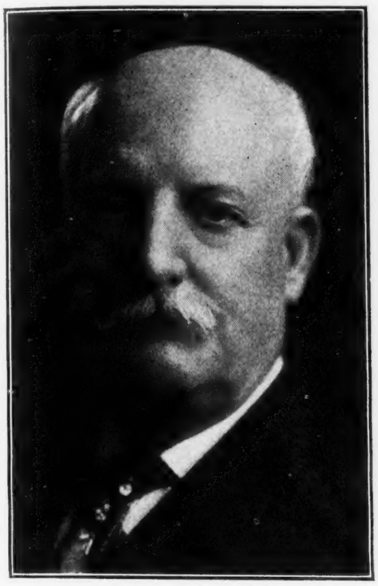
* * *

The Bureau of Mines of the Department of the Interior, Washington, D. C., has issued a bulletin (No. 217), relating to powdered or pulverized coal. The advantages of pulverized coal are clearly set forth, and manufacturers who operate large coal-fired furnaces will find much of value in this bulletin, because, through the use of powdered coal, considerable economies are possible in large power plants.

OBITUARIES

CHARLES E. SHELDON

Charles E. Sheldon, chairman of the board of directors of the Whitman & Barnes Mfg. Co., Akron, Ohio, died in his home in Akron on April 30, after a month's illness, aged seventy-three years. Mr. Sheldon was born in Fitchburg, Mass., April 14, 1850. After leaving school, he went to work for the Whitman & Miles Mfg. Co., Fitchburg, in 1867. This company was later consolidated with other plants and the name was changed to Whitman & Barnes Mfg. Co. In 1872, Mr. Sheldon was made superintendent of the Fitchburg works, and in the fall of 1877 he was sent to Akron to take charge of the works there.



He became a director of the company in 1880, and was made treasurer in 1889. In 1891 he was elected general manager, and in 1899 vice-president and general manager. In 1902 he was elected president and served in that capacity until 1915, when he retired, and was elected chairman of the board of directors. He held the record for continuous service with the company of nearly fifty-six years. He is survived by his widow, a daughter, and three grandchildren.

Mr. Sheldon never lost that intimate personal contact with the men in his employ that was at the bottom of the friendly understanding in the industries in the early days, nor was he ever too busy with his life work to give thought to the welfare of his city and his country; and the encouragement he gave to many efforts contributing to the upbuilding of his home city will be long remembered.

FRANK E. WING

Frank E. Wing, treasurer of the L. S. Starrett Co., Athol, Mass., died at his home in that city on May 13, after a long illness, at the age of fifty-seven years. Mr. Wing was born in Conway, Mass., and attended the public schools of Conway and later the Smith Academy at Hatfield, Mass., from which he graduated in 1882. In the fall of that year he entered Yale University, graduating with the degree of B. A. in 1886.

He came to Athol in 1887, and was employed by the late L. S. Starrett. At that time Mr. Wing was the entire office force of the Starrett shop, being both bookkeeper and shipping cerk, and attending to all the correspondence. When the L. S. Starrett Co. was incorporated in 1900 he was made clerk and a director, and in 1912 he was made treasurer, all of which offices he held until his death. He was intimately connected with the Starrett business throughout its development and expansion from a one-room shop in leased quarters to the large Starrett plant of today.

Mr. Wing was a trustee of the Athol Savings Bank, a member and clerk of the Second Unitarian Society in Athol, and for a number of years chairman of the Athol School Committee, and also a library trustee. He belonged to several fraternal orders. In politics he was a republican. He was married in Athol in 1892 to Miss Edith Mary Smith, who survives him, as does also a son, Donald Goddard Wing, now a freshman at Yale.

Peter Weber, president and general manager of the Sloan & Chace Mfg. Co., Ltd., Newark, N. J., died Wednesday, May 9, at the age of sixty-three. Mr. Weber was born in Germany in 1860, and started to learn the machinists' trade when he was fourteen years old. Two years later he came to the United States alone, landing July 4, 1876. During the next eight years he was employed in a number of machine shops, until in 1884 he entered the employ of Mr. Edison, who was then located at Gerk St., New York City. When the Edison General Electric Co. acquired the old Jones car shops at Schenectady in 1887, he was transferred to that plant, where he worked successively as machinist, toolmaker, inspector, assistant tool-room foreman, foreman, and assistant to the general superintendent. In 1896 he became general superintendent, which position he retained until 1899, when he became connected with Mr. Edison at his West Orange, N. J., plant. Here he remained until the end of 1912, when he acquired the Sloan & Chace Mfg. Co., Ltd., of Newark, N. J., remaining president and general manager of that concern until his death. Mr. Weber's relations with Mr. Edison during the entire time that they were associated were always very friendly, and their business association was terminated only because Mr. Weber acquired his own business which required his full attention.

Dr. Hans Goldschmidt, inventor of the thermit process for welding iron and steel, died suddenly in Baden-Baden, Germany, on May 20, following a paralytic stroke. Dr. Goldschmidt was born in Berlin on January 18, 1861. After finishing his elementary education, he specialized in chemistry, physics, and natural sciences in general at several universities in Germany, receiving the degree of Ph.D. from the University of Heidelberg in 1886. In 1887 he entered the firm of T. Goldschmidt, Essen Ruhr, in partnership with his brother, Dr. Karl Goldschmidt. Under their joint guidance the firm grew to international importance with agencies and allied companies throughout the world.

Dr. Goldschmidt's most important invention was the thermit process, which is now used all over the world for welding iron and steel sections and for producing metals and alloys of high purity. He was president of the Goldschmidt Thermit Co., now known as the Metal & Thermit Corporation, during the period from 1904 to 1916.

L. O. Koven, senior partner in the firm of L. O. Koven & Brother, Jersey City, N. J., and vice-president and treasurer of the Hoevel Mfg. Corporation, died May 17, in his sixty-third year.

Arnold Turner, treasurer and manager of the Turner Machine Co., Danbury, Conn., died on May 12.

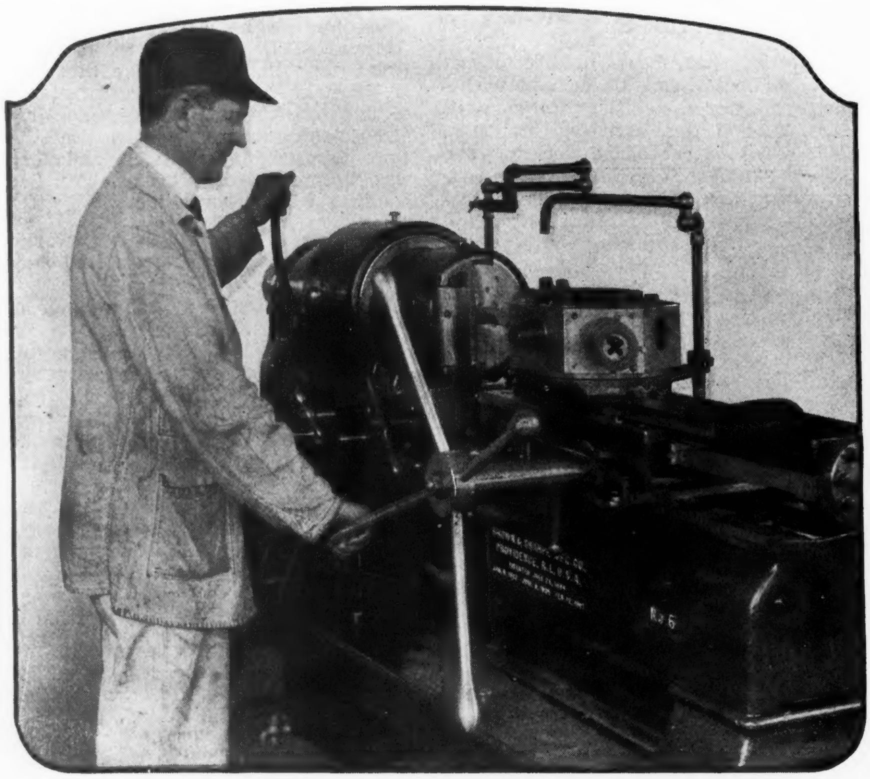
THE AUTOMOTIVE INDUSTRY

The automotive industry, within the space of its short manufacturing career, has advanced until it is today third among the industries of the United States in value of annual output, affording employment each year to about 2,430,000 persons who earn their wage either in the output of the car itself or in producing the materials that go into it. About 600,000 are engaged in the industry itself. Today there are in round numbers, 10,500,000 passenger cars in the United States, or one to every ten persons in the country. The total world registration is but 12,500,000, so that it appears that 83 per cent of the cars now in use are in this country. Of this total approximately 87 per cent are of American manufacture. Each day finds some new place for the motor vehicle.

This development has brought in its wake new questions, or rather old questions demanding new answers. The advance in ten years from 600,000 to 10,500,000 cars brings new requirements in methods, whether they be legislative, industrial or financial in nature. Only trained men can give us the key to their solution. The motor vehicle has become a major unit in transportation, requiring minds of varied training in such fields as civil, chemical, mechanical, metallurgical, and electrical engineering, economics, business administration and finance, research in physical and commercial lines and many other branches, including public service.—*C. C. Hanch in the Journal of the Society of Automotive Engineers.*

* * *

The American Engineering Standards Committee, 29 W. 39th St., New York City, has had eight additional sets of specifications for metals submitted to it by the American Society for Testing Materials. These specifications cover manganese bronze ingots for sand casting; so-called "Government bronze" or gunmetal; brass forging rod; free-cutting brass rod for use in screw machines; naval brass rod for structural purposes; brass ingot metal for sand castings; soft solder; and "high" sheet brass.



BROWN & SHARPE Handy Control

means faster production on Screw Machine Work

200 pages of Screw Machine Facts with a whole section on Wire Feed Screw Machines—a book worth having. Sent to any address on request. Write today asking for Screw Machine Catalog No. 23-G.

On Wire Feed Screw Machines ease of control is essential for rapid production. The controls on the Brown & Sharpe Nos. 4 and 6 Machines are arranged with one object in view—operating convenience. From his position in front of the machine the operator can handle the turret slide and its automatic feed with his right hand; with his left hand he can easily reach the three levers on the headstock: first, the single lever for opening and closing the chuck and feeding the stock; second, the speed change lever; and third, the back gear lever. In front of him is the cross slide with its controls.

This handy arrangement of the levers and controls reduces operating fatigue and makes possible a high rate of production on long runs. Brown & Sharpe Wire Feed Screw Machines will help speed up your production.

BROWN & SHARPE MFG. CO.
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Use BROWN & SHARPE MACHINES *for Production*

Rex Micrometer No. 59 is one of a complete line of 24 Brown & Sharpe Micrometers. These Micrometers are regularly furnished with a Clamp Ring which clamps the spindle and preserves the setting. Supply your tool cribs with these reliable tools.

Put BROWN & SHARPE TOOLS in the hands of your machinists

For the Screw Machine Operator working on pieces held to close limits a good micrometer is a necessity. On second operation work where it is important that partly finished pieces be properly completed, frequent measurements with an accurate micrometer are often essential. Brown & Sharpe Rex Micrometers are ideal tools for screw machine work—strong, light, accurate, with clean-cut graduations that are easy to read. An adequate supply of these accurate, dependable Rex Micrometers in your tool cribs will help maintain uniform accuracy on your screw machine work.

The New Tools described in this booklet are helps toward better workmanship. Write for this "New Tools" booklet today. If you want our Small Tool Catalog also, ask for Catalog No. 28.

BROWN & SHARPE MFG. CO.
Providence, R.I., U.S.A.

BROWN & SHARPE TOOLS

for Accurate Work

TRADE NOTES

Ex-Cell-o Tool & Mfg. Co., Detroit, Mich., is located, since May 12, at 1469 E. Grand Boulevard, Detroit.

Cyril J. Bath & Co., machinery dealers of Cleveland, Ohio, have moved their offices from 1603 to 1738 St. Clair Ave., the offices and warerooms now being under one roof.

Gibb Instrument Co., Bay City, Mich., manufacturer of electric welding equipment, has been appointed distributor of the General Electric Co.'s arc welding electrodes in the middle-western states.

Consolidated Machine Tool Corporation of America, 17 E. 42nd St., New York City, has opened a Detroit district sales office in the General Motors Building, 3044 Grand Blvd., under the management of Roland A. Holmes.

J. N. Lapointe Co., New London, Conn., manufacturer of broaching machines and broaches has appointed Charles A. Strelinger Co., Detroit, Mich., exclusive agent in the state of Michigan for the company's line of broaching machines.

Moltrup Steel Products Co., Beaver Falls, Pa., manufacturer of cold-drawn, milled, and ground specialties, has opened a district sales office at 303 White Bldg., Buffalo, N. Y., in charge of Charles T. Neale, district sales manager.

Link-Belt Co., 910 S. Michigan Ave., Chicago, Ill., has recently removed its Pittsburg branch office from 1501 Park Bldg. to more commodious quarters at 335 Fifth Ave. The change was made necessary by the growing volume of business.

Triplex Machine Tool Corporation, 50 Church St., New York City, has appointed the Herberts Machinery & Supply Co., with showrooms in Los Angeles and San Francisco, exclusive sales agent in the state of California for the Triplex combination bench lathe, milling and drilling machine.

Oilgear Co., 64 Twenty-seventh St., Milwaukee, Wis., manufacturer of variable-speed hydraulic power transmissions, has appointed the Buffalo Machinery Sales Corporation, 881 Ellicott Square, Buffalo, N. Y., as sales representative for Oilgear products in the western New York territory.

United States Electrical Tool Co., Cincinnati, Ohio, has recently opened two new district offices, one at 430 N. High St., Columbus, Ohio, and the other at 412 First St., National Soo Line Bldg., Minneapolis, Minn. E. W. Beeler will be manager of the Columbus office, and Thomas H. Caley, manager of the Minneapolis office.

Whitman & Barnes Mfg. Co., Akron, Ohio, manufacturer of twist drills and reamers, announces that the company's New York office and store has been removed to 99 Chambers St., corner of Church St., one and one-half blocks from its former location. The new quarters will afford increased facilities for carrying larger stocks of drills and reamers.

Bridgeport Brass Co., Bridgeport, Conn., has removed its New York offices from the Woolworth Building to the Pershing Square Building on Park Ave. between 41st and 42nd Sts. F. Morton Clark has been made district sales manager, and Arthur J. Nelson has been made sales manager of the Fabricating Division at the main office in Bridgeport.

Triumph Electric Co., Cincinnati, Ohio, has removed its New York office to 25 Church St., where a representative stock of Triumph type TR motors, as well as squirrel cage, slip ring and direct-current motors, in sizes from 1 to 200 horsepower, will be carried. A similar stock is also carried in the Philadelphia office. G. F. Adams is in charge of the New York office.

Precision & Thread Grinder Mfg. Co., 1 S. 21st St., Philadelphia, Pa., manufacturer of multi-graduated precision grinders, precision thread lead variators, lathe spacing attachments and "cold-set" diamond tools, announces that the price of the 1923 model precision grinder has been reduced 20 per cent. This reduction is made possible by increased production, better manufacturing facilities, and simplified design.

Rollway Bearing Co., Inc., Syracuse, N. Y., is the new name under which the Railway Roller Bearing Co. of the same city is now known. The new name has been adopted because a continually increasing volume of the company's products is being used in the industrial field, and because the bearings made by the company have been advertised and marketed for the last fourteen years under the trade name "Rollway."

McCauley Metal Products Co., Inc., Buffalo, N. Y., has recently taken over a factory at 41-45 Letchworth St., in that city, for the manufacture of the company's line of bicycle accessories, and light and medium sheet metal parts on a contract basis. A complete plating and enameling department makes it possible to furnish any finish desired. H. J. McCauley is president, and Frank E. Denley of Wheeling, W. Va., will soon join the corporation as factory manager.

Rockford Milling Machine Co., Rockford, Ill., has taken over the manufacture of the Cadillac line of single- and double-end centering and drilling machines, as well as the Cadillac bench centers, formerly manufactured and sold by the Cadillac Machinery Co., Detroit, Mich. In addition to building a complete line of standard machines, the design of which it is planned to improve, the company will be in a position to build special machines and attachments for drilling and centering work.

Skinner Chuck Co., New Britain, Conn., has bought from the Production Tool Equipment Co. of Bridgeport, all the dies, patterns, fixtures, machinery, etc., for the production of the Ketchum vise, which is adapted for use on milling and drilling machines. The Skinner Chuck Co. plans to develop a complete line of milling machine vises with and without swivel bases. The vises will be adapted for a wide range of work—from large milling machine operations to small tool-room operations or special production work.

Stovel & Brinkerhoff, engineers and constructors, 136 Liberty St., New York City, announce the addition of H. M. Van Gelder as a partner in their firm, and a change of name from Stovel & Brinkerhoff to Stovell, Brinkerhoff & Van Gelder. Mr. Van Gelder, a member of the American Institute of Electrical Engineers, has had over twenty years' experience in electrical engineering and construction. He was formerly electrical engineer and managing engineer of Westinghouse, Church, Kerr & Co., and recently project engineer on railroad electrification work with Gibbs & Hill.

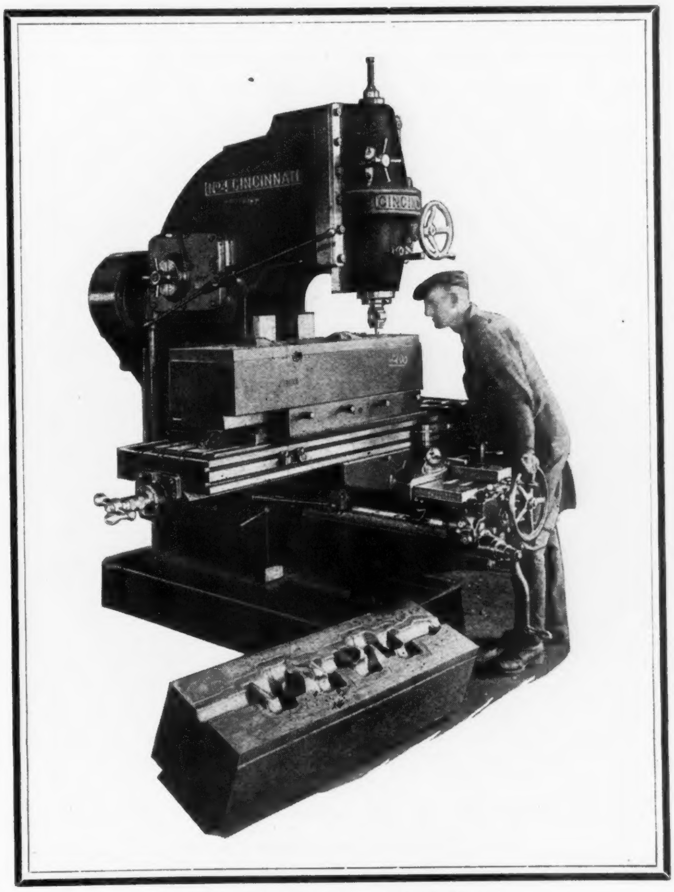
Battersby & Sample, dealers in high-production tools and machinery, Philadelphia, Pa., have recently taken display and office space at the Machinery Exhibition and Sales Department of the Bourse. They are exclusive representatives of Goddard & Goddard Co., Detroit, Mich., manufacturer of milling cutters; Chapin-Skelton Corporation, Syracuse, N. Y., manufacturer of taper reamers; Cogsdill Mfg. Co., Detroit, manufacturer of center drills; Logansport Machine Co., Logansport, Ind., manufacturer of air chucks; Porter-Cable Machine Co., manufacturer of production and engine lathes. A complete line of the tools and machinery that they represent will be displayed.

Rivett Lathe & Grinder Co., Brighton, Boston, Mass., which has been in receivership since March, 1922, was sold by the receiver on April 14, 1923, the purchase including the entire plant, equipment, and business of the company. The purchaser is the Creditor's Protective Committee, by whom the company has been reorganized under the name of Rivett Lathe & Grinder Corporation. Sufficient new capital has been subscribed to put the company on a suitable financial basis. The present management, under the direction of T. S. Ross as president and general manager, will operate the plant and continue the business, producing the same lines of machinery as in the past.

Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., announces the following changes in personnel: Graeme Ross has been appointed manager of the Kansas City office to succeed F. S. Rossman; E. L. Doty, district service manager of the Buffalo branch office, has been made engineering assistant, service department, with headquarters in East Pittsburg, and J. A. Atkinson has been appointed Buffalo service manager; C. W. Jones, has become general foreman of the controller department, and C. A. Fike general foreman of the coils and insulation department at the East Pittsburg Works; J. H. Hartman has been appointed general foreman of the storekeeping department, and W. S. Oswald general foreman of the railway motor department at the East Pittsburg works.

E. W. Bliss Co., Brooklyn, N. Y., manufacturer of pressed-metal machinery, automatic can machinery, dies, and special machinery, has recently moved its sales and executive offices to the South Brooklyn plant of the company, which is located at the foot of 53rd St. This plant comprises a group of seventeen buildings, covering a ground area of eighteen acres, and has a total floor area of twenty-one acres. It is about a half mile long. During the war, many large additions were made to the plant to meet war requirements until it reached its present proportions. At the termination of hostilities, there was available a considerable amount of space and equipment, so the company determined to consolidate its two Brooklyn plants, and accordingly has moved practically all the machine equipment from the Adams St. plant to the South Brooklyn plant.

CINCINNATI MILLERS



CINCINNATI No. 4 VERTICAL

DIE SINKING

Complete control from one position enables the operator to handle heavy dies with ease.

The convenient location of the power feed control levers (cross, vertical and longitudinal) encourages the operator to use the *power* feeds for roughing out the die. The right feed for any given cut is obtained through the movement of a single lever, without changing position.

An auxiliary handwheel at the front of the saddle for the longitudinal table feed, is convenient when hand profiling.

And the spindle head can be instantly adjusted vertically.

For the long table adjustments the power quick traverse is used.

Have our Specialist make a study of your work

THE CINCINNATI MILLING MACHINE CO., Cincinnati, Ohio

COMING EVENTS

June 7-9—Meeting of the Taylor Society at Hotel Onondaga, Syracuse, N. Y.

June 11-14—Annual meeting of the Electric Power Club in Hot Springs, Va.; headquarters, Hotel Homestead. Executive secretary, S. N. Clarkson, Kirby Bldg., Cleveland, Ohio.

June 14-15—Eastern sectional meeting of the American Society for Steel Treating in Bethlehem, Pa. National secretary, W. H. Eisenman. Hotel reservations made through George C. Lilly, superintendent of heat-treatment, Bethlehem Steel Co., Bethlehem, Pa.

June 14-16—Fourth annual conference of the National Association of Office Managers at Detroit. G. S. Childs, Alexander Hamilton Institute, 13 Astor Place, New York City, secretary.

June 19-23—Summer meeting of the Society of Automotive Engineers at Spring Lake, N. J. Secretary, Coker F. Clarkson, 29 W. 39th St., New York City.

June 25-29—Annual convention of the American Institute of Electrical Engineers at Swampscott, Mass. For further information, address the secretary's office, 29 W. 39th St., New York City.

June 25-30—Twenty-sixth annual meeting of the American Society for Testing Materials in Atlantic City, N. J.; headquarters, Chalfonte-Haddon Hall Hotel. C. L. Warwick, 1315 Spruce St., Philadelphia, Pa., secretary.

August 20-30—Meeting of the American Institute of Mining and Metallurgical Engineers at Quebec, Canada. Secretary, F. F. Sharpless, 29 W. 39th St., New York City.

September 17-22—Ninth national exposition of chemical industries, in the Grand Central Palace, New York City. For further information address National Exposition of Chemical Industries, Grand Central Palace, New York.

September 24-28—Meeting of the Association of Iron and Steel Electrical Engineers at Buffalo, N. Y., in conjunction with the Iron and Steel Exposition held in the Buffalo Auditorium. Further information may be obtained from the Association of Iron and Steel Electrical Engineers, Empire Building, Pittsburg, Pa.

October 8-12—Annual convention of the American Society for Steel Treating to be held in Pittsburg, Pa., in connection with an international steel exposition. W. H. Eisenman, 4600 Prospect Ave., Cleveland, Ohio, national secretary.

October 25-26—Production meeting of the Society of Automotive Engineers at Cleveland, Ohio. Further information may be obtained from the society's headquarters, 29 W. 39th St., New York City.

SOCIETIES, SCHOOLS AND COLLEGES

University of Missouri, Rolla, Mo. Catalogue 1922-1923 of the School of Mines and Metallurgy containing the calendar, curricula, and other information.

Hebrew Technical Institute, Stuyvesant and E. 9th Sts., New York City. Catalogue for 1923, containing calendar, outlines of courses, requirements for admission, etc.

NEW BOOKS AND PAMPHLETS

Construction and Operation of a Two-circuit Radio Receiving Equipment with Crystal Detector. 14 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Circular No. 121 of the Bureau of Standards. Price 5 cents.

Auxiliary Condensers and Loading Coil Used with Simple Homemade Radio Receiving Outfits. 19 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Circular No. 137 of the Bureau of Standards. Price, 10 cents.

An Investigation of the Properties of Chilled Iron Car Wheels—Part III. By J. M. Snodgrass and F. H. Guldner. 100 pages, 6 by 9 inches. Published by the University of Illinois, Urbana, Ill., as Bulletin No. 135 of the Engineering Experiment Station. Price, 50 cents.

Lathe Breakdown Tests of Some Modern High-speed Tool Steels. By H. J. French and Jerome Strauss. 48 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Technologic Paper No. 228 of the Bureau of Standards. Price, 15 cents.

Tables for the Calculation of the Inductance of Circular Coils of Rectangular Cross-section. By Frederick W. Grover. 35 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Scientific Paper No. 455 of the Bureau of Standards. Price, 10 cents.

Properties of Electrical Insulating Materials of the Laminated Phenol-Methylene Type. By J. H. Dellinger and J. L. Preston. 125 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Technologic Paper No. 216 of the Bureau of Standards. Price, 30 cents.

Pulling Together. By John T. Broderick. 167 pages, 5 by 7½ inches. Published by Robson & Adee, Schenectady, N. Y. Price, $2.

This is the sixth edition of a book dealing with human relations in industry, discussing, in particular, the plan of employe representation. The book is written in the form of a conversation between a salesman and a manufacturer of broad vision, who describes the success of the plan in his own plant. It should be of interest to managers who seek light on industrial democracy as a means of reducing friction between employers and employes. The new feature of this edition is a short sequel entitled "Untouched Wealth," which contains further thoughts on the matter of obtaining cooperation between capital and labor through understanding and mutuality of interest.

The Mechanisms of Machine Tools. By Thomas R. Shaw. 351 pages, 9 by 11 inches; 433 illustrations. Published by the Oxford University Press, American Branch, New York City. Price, $14.

The author of this book has endeavored to place on record the essential principles embodied in machine tool design. He has collected this information from many sources including the transactions of engineering societies and the technical journals in the machine tool field. The illustrations are mainly line engravings, showing quite clearly the details of the design being described. A list of the chapter heads will furnish a comprehensive idea of the contents of the book: Evolution, Types, and Functions of Machine Tools; Materials of Construction; Gearing; Design of Framework; Sliding Bearings; Bearings for Shafts and Spindles; Transmission of Power; Reverse Motions; Hand and Automatic Control; Chucking Devices; Trip, Indexing, and Locking Devices.

Synthetic Resins and Their Plastics. By Carleton Ellis. 514 pages, 6 by 9 inches. Published by the Chemical Catalog Co., Inc., 19 E. 24th St., New York City. Price, $6.

This book has been written for the purpose of placing before the chemist extensive data on a great variety of synthetic products of a resinous character, which may lend themselves to substitution in various places where natural resins are now used. The industrial application of synthetic resins has been considered in detail. The section of the book which is of particular interest to the machine-building field is that dealing with equipment for molding plastic compositions, and methods of molding. The chapter on molds and molding equipment describes various types of molds in detail, methods of heating molds, materials used, correct and incorrect designs of molds, shrinkage allowance, fabrication of molds, and repairs and maintenance. Considerable space is given to a description of different types of presses employed for plastic molding, all of which are illustrated.

Accurate Tool Work. C. L. Goodrich and F. A. Stanley, 300 pages, 6 by 9 inches. Published by the McGraw-Hill Book Co., Inc., 370 Seventh Ave., New York City. Price, $3.

This is the second edition of a book dealing with the principles of toolmaking and applications of the important processes and methods of precision work. It takes up the construction of jigs, fixtures, and other special tools for insuring interchangeability of product, explaining how the holes in a jig can be accurately located and bored, and describing examples of jig work. The use of master plates, buttons, disks, size-blocks, sine bars, etc., has been treated at length, together with the processes of making master plates for various purposes, the use of test indicators, accurate gages, the microscope, and other appliances. Considerable space has been devoted to ways and means of dealing with angular and taper work. Eight chapters deal with the subject of gage design and construction, covering methods of making plugs and rings, ring thread gages, flat gages, snap gages, gages for automobile parts, and essential devices used by the toolmaker on this class of work.

The Study of Electricity by the Deductive Method. By George Ira Alden. 110 pages, 4¾ by 7½ inches. Published by the Commonwealth Press, Worcester, Mass.

This book presents the subject of electricity to the student by the deductive method. The method is based on the analogy of an endless flexible shaft revolving about its geometric axis, and an attempt has been made to extend the analogy to the solution of all problems of electric transmission of energy by both direct and alternating current. The first chapter contains a discussion of the essential facts concerning magnetism. This is followed by chapters on mechanics; statement and application of analogy and working hypothesis; application of analogy to the generator; induction; combination of out-of-phase torques; the condenser; and measuring instruments. As a help to the student a brief paragraph is placed at the beginning of each chapter which indicates the trend of thought that will be followed. The last chapter contains a group of problems illustrating some types of circuits. A discussion of certain points which for the sake of clearness have been inserted in the text without comment, is given in the form of an appendix.

The Engineering Index—1922. 675 pages, 6¼ by 9½ inches. Published by the American Society of Mechanical Engineers, 29 W. 39th St., New York City. Price, $6.

This is the twenty-first volume of the Engineering Index and the fourth one to be issued by the American Society of Mechanical Engineers. In its compilation a review has been made of about 1300 periodicals, reports and other publications regularly received during the year by the Engineering Society's Library, and from over 600 of these the articles to be indexed have been selected. These represent not only publications printed in the United States but also periodicals printed in foreign countries; thus, it is safe to say that the Index completely covers all the important technical articles appearing during the year 1922. In this edition the items have been made unusually concise, because it is believed that the value of the Index increases with the number of references it contains. The volume includes not only the 1922 periodicals, but also 1921 publications which came in too late to be included in the 1921 Index. The classification and the system of cross-indexing have been perfected. The Index is classified by subjects arranged alphabetically.

Tool Engineering—Turning, Boring, and Grinding. By Albert A. Dowd and Frank W. Curtis. 340 pages 6 by 9 inches; 216 illustrations. Published by the McGraw-Hill Book Co., Inc., 370 Seventh Ave., New York. Price, $3.50.

This is the second volume of a series of three books covering the science of tool engineering. The present book deals with important factors affecting the design of tools and fixtures for turning, boring, and grinding operations. It gives the reasons why certain methods are better than others, as well as many graphic examples illustrating the use of the principles outlined. The first volume covered the subject of tool engineering as applied to the design of jigs and fixtures, and the third volume will deal with the design of punches, dies, and gages used in production work. The material is divided into sixteen chapters, headed as follows: Consideration of Turret and Engine Lathe Tooling; Design of Chuck Jaws; Second Operation Work; Design of Special Fixtures; Inside Holding Methods; Turning Tools for Turret Lathes; Boring Tools; Facing Tools; Recessing Tools; Reamers and Floating Holders; Cross-slide Tools; Attachments for Turret Lathes; Lay-out Work; Vertical Lathes, Vertical Machines, and Boring Mills; Tapered and Curved Surfaces; and Fixtures for Grinding.

Problems in Machine Design. By O. A. Leutwiler. 140 pages, 6 by 9 inches; illustrated. Published by the McGraw-Hill Book Co., Inc., New York City. Price, $1.50.

The purpose of the author, in preparing this book, has been to present a series of isolated problems covering the various parts of the subject of machine design. Practically all of the problems have been taken directly from existing machines. The majority of the problems in Sections I to XV deal with simple isolated machine parts. Section XV includes problems, in the solution of which the student makes a complete force and stress analysis of all the elements used in the machine. Problems taking up the design of simple machines are given in Section XVI. Section XVII contains a number of tables of use in connection with design work. An idea of the problems covered will be obtained from the following list of contents: Stresses and Strains in Machine Parts; Riveted Connections; Bolts and Screws; Cotter and Pin Connections; Cylinders, Plates and Springs; Belting; Rope Transmission; Chain Transmission; Friction Transmission; Spur Gearing; Bevel and Screw Gearing; Couplings and Clutches; Brakes; Shafting and Bearings; General Problems; Design Problems; and Tables.

Financial Incentives for Employes and Executives. Compiled and edited by Daniel Bloomfield. Published in two volumes, containing 325 pages and 407 pages, 5 by 8 inches, respectively. Published by the H. W. Wilson Co., 958 University Ave., New York City. Price for two volumes, $4.80.

The widespread interest in all forms of financial incentives for employes and executives has led to the compilation of a reference book describing such incentives in detail. Better systems of reward for the effort of employes are constantly being devised, and the present work, which is published in two volumes, brings together in convenient form the best of such systems, offering suggestions for adaptation to organizations of different kinds. The executive will find in this compilation ideas gathered from a large number of publications and reports, and from original investigations covering over 1000 concerns and plants. The first volume, containing Parts I and II, covers types of wage systems; piece work; day work and week work; and bonus plans of various kinds. The second volume, containing Parts III and IV, discusses thrift plans; profit-sharing; stock participation plans; mutual benefit associations; pension plans, incentives in retail stores; compensation of salesmen; compensation of office workers; and incentives for foremen and executives. The work is thoroughly indexed, and in addition, contains a bibliography of books relating to this subject.